

Handbook of Research on

Climate Change and the Sustainable Financial Sector



Odunayo Magret Olarewaju and Idris Olayiwola Ganiyu

IGI Global
PUBLISHER OF TIMELY KNOWLEDGE

Copyright 2021. Business Science Reference. All rights reserved. May not be reproduced in any form without permission from the publisher, except fair uses permitted under U.S. or applicable copyright law.

Handbook of Research on Climate Change and the Sustainable Financial Sector

Odunayo Magret Olarewaju
Durban University of Technology, South Africa

Idris Olayiwola Ganiyu
University of KwaZulu-Natal, South Africa



A volume in the Advances in Finance, Accounting,
and Economics (AFAE) Book Series

Published in the United States of America by
IGI Global
Business Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA, USA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: <http://www.igi-global.com>

Copyright © 2021 by IGI Global. All rights reserved. No part of this publication may be reproduced, stored or distributed in any form or by any means, electronic or mechanical, including photocopying, without written permission from the publisher. Product or company names used in this set are for identification purposes only. Inclusion of the names of the products or companies does not indicate a claim of ownership by IGI Global of the trademark or registered trademark.

Library of Congress Cataloging-in-Publication Data

Names: Olarewaju, Odunayo, 1987- editor. | Ganiyu, Idris, 1978- editor.
Title: Handbook of research on climate change and the sustainable financial sector / Odunayo Olarewaju and Idris Ganiyu, editors.
Description: Hershey, PA : Business Science Reference, 2021. | Includes bibliographical references and index. | Summary: "This edited book presents a variety of chapters on many evident impacts of climate change on various sectors of the world economy, especially the financial sector which is seen as a specific qualitative predictor of the potential socio-economic effects of climate change"-- Provided by publisher.
Identifiers: LCCN 2021004491 (print) | LCCN 2021004492 (ebook) | ISBN 9781799879671 (hardcover) | ISBN 9781799879695 (ebook)
Subjects: LCSH: Finance--Environmental aspects. | Sustainable development. | Climatic changes--Economic aspects.
Classification: LCC HG101 .C57 2021 (print) | LCC HG101 (ebook) | DDC 332--dc23
LC record available at <https://lcn.loc.gov/2021004491>
LC ebook record available at <https://lcn.loc.gov/2021004492>

This book is published in the IGI Global book series Advances in Finance, Accounting, and Economics (AFAE) (ISSN: 2327-5677; eISSN: 2327-5685)

British Cataloguing in Publication Data

A Cataloguing in Publication record for this book is available from the British Library.

All work contributed to this book is new, previously-unpublished material. The views expressed in this book are those of the authors, but not necessarily of the publisher.

For electronic access to this publication, please contact: eresources@igi-global.com.



Advances in Finance, Accounting, and Economics (AFAE) Book Series

Ahmed Driouchi
Al Akhawayn University, Morocco

ISSN:2327-5677
EISSN:2327-5685

MISSION

In our changing economic and business environment, it is important to consider the financial changes occurring internationally as well as within individual organizations and business environments. Understanding these changes as well as the factors that influence them is crucial in preparing for our financial future and ensuring economic sustainability and growth.

The **Advances in Finance, Accounting, and Economics (AFAE)** book series aims to publish comprehensive and informative titles in all areas of economics and economic theory, finance, and accounting to assist in advancing the available knowledge and providing for further research development in these dynamic fields.

COVERAGE

- Behavioral Economics
- Finance and Accounting in SMEs
- Bankruptcy
- International Economics
- Banking
- Economics of Risks, Uncertainty, Ambiguity, and Insurance
- Applied Finance
- Public Finance
- Finance
- Wages and Employment

IGI Global is currently accepting manuscripts for publication within this series. To submit a proposal for a volume in this series, please contact our Acquisition Editors at Acquisitions@igi-global.com or visit: <http://www.igi-global.com/publish/>.

The Advances in Finance, Accounting, and Economics (AFAE) Book Series (ISSN 2327-5677) is published by IGI Global, 701 E. Chocolate Avenue, Hershey, PA 17033-1240, USA, www.igi-global.com. This series is composed of titles available for purchase individually; each title is edited to be contextually exclusive from any other title within the series. For pricing and ordering information please visit <http://www.igi-global.com/book-series/advances-finance-accounting-economics/73685>. Postmaster: Send all address changes to above address. Copyright © 2021 IGI Global. All rights, including translation in other languages reserved by the publisher. No part of this series may be reproduced or used in any form or by any means – graphics, electronic, or mechanical, including photocopying, recording, taping, or information and retrieval systems – without written permission from the publisher, except for non commercial, educational use, including classroom teaching purposes. The views expressed in this series are those of the authors, but not necessarily of IGI Global.

Titles in this Series

For a list of additional titles in this series, please visit: <http://www.igi-global.com/book-series/advances-finance-accounting-economics/73685>

Applied Doughnut Economics and Neuroeconomic Psychology for Business and Politics

Torben Larsen (DEALs Online Collaborative Platform, Denmark)

Business Science Reference • © 2021 • 257pp • H/C (ISBN: 9781799864240) • US \$195.00

Handbook of Research on Islamic Social Finance and Economic Recovery After a Global Health Crisis

Salina Kassim (Institute of Islamic Banking and Finance, International Islamic University Malaysia, Malaysia) Anwar Hasan Abdullah Othman (Institute of Islamic Banking and Finance, International Islamic University Malaysia, Malaysia) and Razali Haron (Institute of Islamic Banking and Finance, International Islamic University Malaysia, Malaysia)

Business Science Reference • © 2021 • 410pp • H/C (ISBN: 9781799868118) • US \$295.00

Money Laundering and Terrorism Financing in Global Financial Systems

Abdul Rafay (University of Management and Technology, Pakistan)

Business Science Reference • © 2021 • 374pp • H/C (ISBN: 9781799887584) • US \$215.00

Financial Management and Risk Analysis Strategies for Business Sustainability

Joaquín Enríquez-Díaz (University of A Coruña, Spain) Laura Castro-Santos (University of A Coruña, Spain) and Félix Puime-Guillén (University of A Coruña, Spain)

Business Science Reference • © 2021 • 320pp • H/C (ISBN: 9781799876342) • US \$215.00

Theory of Shocks, COVID-19, and Normative Fundamentals for Policy Responses

Olga Ivanovna Pilipenko (The Russian Presidential Academy of National Economy and Public Administration, Russia) Zoya Andreevna Pilipenko (Bank of Russia, Russia) and Andrey Igorevich Pilipenko (The Russian Presidential Academy of National Economy and Public Administration, Russia)

Business Science Reference • © 2021 • 396pp • H/C (ISBN: 9781799843092) • US \$195.00

Handbook of Research on Theory and Practice of Financial Crimes

Abdul Rafay (University of Management and Technology, Pakistan)

Business Science Reference • © 2021 • 650pp • H/C (ISBN: 9781799855675) • US \$345.00

Comparative Research on Earnings Management, Corporate Governance, and Economic Value

Elisabete S. Vieira (University of Aveiro, Portugal) Mara Madaleno (University of Aveiro, Portugal) and Graça Azevedo (University of Aveiro, Portugal)

Business Science Reference • © 2021 • 433pp • H/C (ISBN: 9781799875963) • US \$215.00



701 East Chocolate Avenue, Hershey, PA 17033, USA

Tel: 717-533-8845 x100 • Fax: 717-533-8661

E-Mail: cust@igi-global.com • www.igi-global.com

Editorial Advisory Board

Ethel Ndidiamaka Abe, *University of Johannesburg, South Africa*

Michael Olajide Adelowotan, *University of Johannesburg, South Africa*

Olufemi Patrick Adeyeye, *Federal University Oye-Ekiti, Nigeria*

Felicia Omolara Afolabi, *Department of Chemical Engineering, Durban University of Technology, South Africa*

Edward Kwaku Armah, *Durban University of Technology, South Africa*

Ayansola Olatunji Ayandibu, *Department of Business Management, Faculty of Commerce, Administration, and Law, University of Zululand, South Africa*

Joyce Adefunke Ayeni, *University of KwaZulu-Natal, South Africa*

Andrisha Beharry-Ramraj, *University of KwaZulu-Natal, South Africa*

Aboluwodi Damilola, *University of KwaZulu-Natal, South Africa*

Vanessa Gaffar, *Universitas Pendidikan, Indonesia*

Oladimeji Hezekiah, *Durban University of Technology, South Africa*

Babatunde Samuel Lawrence, *University of KwaZulu-Natal, South Africa*

Haruna Maama, *Durban University of Technology, South Africa*

Kamilla Marchewka-Bartkowiak, *Poznań University of Economics and Business, Poland*

Ferina Marimuthu, *Durban University of Technology, South Africa*

Shame Mugova, *Durban University of Technology, South Africa*

Khairunnisa Musari, *K. H. Ahmad Shiddiq State Islamic University (UIN), Indonesia & State Institute for Islamic Studies (IAIN) of Jember, Indonesia*

Adefemi A. Obalade, *University of KwaZulu-Natal, South Africa*

Olufemi Michael Oladejo, *University of KwaZulu-Natal, South Africa*

Olusola Olawale Olarewaju, *University of KwaZulu-Natal, South Africa*

Prince Sarpong, *School of Financial Planning Law, Faculty of Law, University of the Free State, South Africa*

Adenike Oyelola Soogun, *Management College of Southern Africa (MANCOSA), South Africa*

List of Contributors

Adelowotan, Michael Olajide / <i>University of Johannesburg, South Africa</i>	52
Adeyeye, Olufemi Patrick / <i>Federal University Oye Ekiti, Nigeria</i>	304, 411
Afolabi, Olayinka Olubukola / <i>HANDEL Institute, Nigeria</i>	134
Akbar, Khalida / <i>Durban University of Technology, South Africa</i>	316
Akinsola, Temiloluwa O. / <i>Bowen University, Nigeria & University of Johannesburg, South Africa</i>	52
Akpabio, Edidiong Samuel / <i>Trinity University, Nigeria</i>	202
Arise, Omolola Ayobamidele / <i>University of Kwa-Zulu Natal, South Africa</i>	286
Asaolu, Adepoju Adeoba / <i>Federal University Oye Ekiti, Nigeria</i>	411
Ayandibu, Ayansola Olatunji / <i>University of Zululand, South Africa</i>	316, 399
Ayeni, Joyce Adefunke / <i>University of KwaZulu-Natal, South Africa</i>	229
Balogun, Adekunle Alexander / <i>Federal University Oye Ekiti, Nigeria</i>	304
Devkota, Niranjana / <i>Quest International College, Pokhara University, Lalitpur, Nepal</i>	84
Doorasamy, Mishelle / <i>University of KwaZulu-Natal, South Africa</i>	387
Fapetu, Oladapo / <i>Federal University Oye Ekiti, Nigeria</i>	304
Gaffar, Vanessa / <i>Universitas Pendidikan Indonesia, Indonesia</i>	171
Ikeh, Nnanna Ephraim / <i>University of Nigeria, Nsukka, Nigeria</i>	202
Jarno, Klaudia / <i>Poznan University of Economics and Business, Poland</i>	34
Khanal, Ghanashyam / <i>Tribhuvan University, Kathmandu, Nepal</i>	84
Koeswandi, Tika / <i>Universitas Pendidikan Indonesia, Indonesia</i>	171
Lawrence, Babatunde Samuel / <i>University of KwaZulu-Natal, South Africa</i>	387
Maama, Haruna / <i>Faculty of Accounting and Informatics, Durban University of Technology,</i> <i>South Africa</i>	431
Machebe, Ndubuisi Samuel / <i>University of Nigeria, Nsukka, Nigeria</i>	202
Mamba, Sthokozile / <i>University of KwaZulu-Natal, South Africa</i>	99
Marchewka-Bartkowiak, Kamilla / <i>Poznan University of Economics and Business, Poland</i>	34
Marimuthu, Ferina / <i>Faculty of Accounting and Informatics, Durban University of Technology,</i> <i>South Africa</i>	431
Msomi, Thabiso Sthembiso / <i>Durban University of Technology, South Africa</i>	71, 252
Musari, Khairunnisa / <i>K. H. Ahmad Shiddiq State Islamic University, Indonesia</i>	1
Nomlala, Bomi Cyril / <i>University of KwaZulu-Natal, South Africa</i>	190
Nyika, Joan / <i>Technical University of Kenya, Kenya</i>	118
Nzuza, Zwelihle Wiseman / <i>Durban University of Technology, South Africa</i>	463
Oladimeji, Hezekiah / <i>Durban University of Technology, South Africa</i>	134
Olarewaju, Odunayo Magret / <i>Durban University of Technology, South Africa</i>	71, 252, 374
Olarewaju, Olusola Olawale / <i>University of KwaZulu-Natal, South Africa</i>	190

Paudel, Udaya Raj / <i>Quest International College, Pokhara University, Lalitpur, Nepal</i>	84
Ramasamy-Gurayah, Jayrusha / <i>University of KwaZulu-Natal, South Africa</i>	446
Ramlachan, Kiosha / <i>University of KwaZulu-Natal, South Africa</i>	144
Ramraj, Andrisha Beharry / <i>University of KwaZulu-Natal, South Africa</i>	99, 144, 446
Sarpong, Prince / <i>University of the Free State, South Africa</i>	17
Shewell, Patricia Maureen / <i>University of Kwa-Zulu Natal, South Africa</i>	286
Singh, Shalini / <i>Durban University of Technology, South Africa</i>	134
Soogun, Adenike Oyelola / <i>Management College of Southern Africa, South Africa</i>	353
Tshabalala, Mkhothi / <i>University of KwaZulu-Natal, South Africa</i>	446
Udeh, Valentine Chidozie / <i>University of Nigeria, Nsukka, Nigeria</i>	202
Unurlu, Cigdem / <i>Trakya University, Turkey</i>	267
Usharani, Bhimavarapu / <i>Koneru Lakshmaiah Education Foundation, India</i>	331
Uzochukwu, Ifeanyi Emmanuel / <i>University of Nigeria, Nsukka, Nigeria</i>	202
Vezi-Magigaba, Makhosazana Faith / <i>University of Zululand, South Africa</i>	399

Table of Contents

Foreword	xxii
Preface	xxiv
Acknowledgment	xxxix
Chapter 1	
Green Sukuk, Islamic Green Financing: A Lesson Learned From Indonesia	1
<i>Khairunnisa Musari, K. H. Ahmad Shiddiq State Islamic University, Indonesia</i>	
Chapter 2	
Grey Rhinos and Deep Risk: How Climate Change Will Impact Financial Planning	17
<i>Prince Sarpong, University of the Free State, South Africa</i>	
Chapter 3	
Revenues of the EU ETS Auctioning and Their Impact on Budgetary Allocation: The Case of Poland	34
<i>Kamilla Marchewka-Bartkowiak, Poznan University of Economics and Business, Poland</i>	
<i>Klaudia Jarno, Poznan University of Economics and Business, Poland</i>	
Chapter 4	
SDG 13 and Environmental Governance in the Nigerian Financial Sector	52
<i>Temiloluwa O. Akinsola, Bowen University, Nigeria & University of Johannesburg, South Africa</i>	
<i>Michael Olajide Adelowotan, University of Johannesburg, South Africa</i>	
Chapter 5	
Nexus of Climate Change and Sustainable Real Estate	71
<i>Thabiso Sthembiso Msomi, Durban University of Technology, South Africa</i>	
<i>Odunayo Magret Olarewaju, Durban University of Technology, South Africa</i>	

Chapter 6

- Is Current Understanding Adequate for Green Banking Practices in Nepal: A Lesson Learned 84
Niranjana Devkota, Quest International College, Pokhara University, Lalitpur, Nepal
Udaya Raj Paudel, Quest International College, Pokhara University, Lalitpur, Nepal
Ghanashyam Khanal, Tribhuvan University, Kathmandu, Nepal

Chapter 7

- The Impact of Climate Change on Human Resource Management in the Global Economy 99
Sthokozile Mamba, University of KwaZulu-Natal, South Africa
Andrisha Beharry Ramraj, University of KwaZulu-Natal, South Africa

Chapter 8

- The Relationship Between Climate Change and Financial Stability 118
Joan Nyika, Technical University of Kenya, Kenya

Chapter 9

- Sustainability and Green Operations Management: Concept, Theory, and Practice 134
Hezekiah Oladimeji, Durban University of Technology, South Africa
Shalini Singh, Durban University of Technology, South Africa
Olayinka Olubukola Afolabi, HANDEL Institute, Nigeria

Chapter 10

- Human Resource Development's Role in Communicating the Risk of Climate Change and Promoting Pro-Environmental Behavioural Changes 144
Kiosha Ramlachan, University of KwaZulu-Natal, South Africa
Andrisha Beharry Ramraj, University of KwaZulu-Natal, South Africa

Chapter 11

- Climate Change and the Sustainable Small and Medium-Sized Enterprises 171
Vanessa Gaffar, Universitas Pendidikan Indonesia, Indonesia
Tika Koeswandi, Universitas Pendidikan Indonesia, Indonesia

Chapter 12

- Climate Change and Insurance Business in Developing Economies 190
Olusola Olawale Olarewaju, University of KwaZulu-Natal, South Africa
Bomi Cyril Nomlala, University of KwaZulu-Natal, South Africa

Chapter 13

- Climate Change and Agricultural Sustainability in Nigeria: An Assessment of the Crop, Forestry, Fisheries, and Livestock Sub-Sectors 202
Edidiong Samuel Akpabio, Trinity University, Nigeria
Valentine Chidozie Udeh, University of Nigeria, Nsukka, Nigeria
Ifeyanyi Emmanuel Uzochukwu, University of Nigeria, Nsukka, Nigeria
Nnanna Ephraim Ikeh, University of Nigeria, Nsukka, Nigeria
Ndubuisi Samuel Machebe, University of Nigeria, Nsukka, Nigeria

Chapter 14	
Climate Change Lessons for Managers in a Sustainable Economy	229
<i>Joyce Adefunke Ayeni, University of KwaZulu-Natal, South Africa</i>	
Chapter 15	
Climate Change and the Sustainability of Small Businesses in Africa	252
<i>Thabiso Sthembiso Msomi, Durban University of Technology, South Africa</i>	
<i>Odunayo Magret Olarewaju, Durban University of Technology, South Africa</i>	
Chapter 16	
Sustainability Tourism and Socio-Economic Development	267
<i>Cigdem Unurlu, Trakya University, Turkey</i>	
Chapter 17	
Material Flow Cost Accounting (MFCA): A Green Management Tool (GMT) for Hotel Business..	286
<i>Omolola Ayobamidele Arise, University of Kwa-Zulu Natal, South Africa</i>	
<i>Patricia Maureen Shewell, University of Kwa-Zulu Natal, South Africa</i>	
Chapter 18	
Financing Green Electricity in Nigeria for Economic Growth	304
<i>Olufemi Patrick Adeyeye, Federal University Oye Ekiti, Nigeria</i>	
<i>Adekunle Alexander Balogun, Federal University Oye Ekiti, Nigeria</i>	
<i>Oladapo Fapetu, Federal University Oye Ekiti, Nigeria</i>	
Chapter 19	
Green Marketing, Green Management, and Sustainability	316
<i>Ayansola Olatunji Ayandibu, University of Zululand, South Africa</i>	
<i>Khalida Akbar, Durban University of Technology, South Africa</i>	
Chapter 20	
Long-Term Effects of Climate Change on Housing Market analytics in Amaravati, Capital of Andhra Pradesh in India, Using Machine Learning.....	331
<i>Bhimavarapu Usharani, Koneru Lakshmaiah Education Foundation, India</i>	
Chapter 21	
Nexus of Green Management, Green Marketing, Sustainability, and Financial Performance	353
<i>Adenike Oyelola Soogun, Management College of Southern Africa, South Africa</i>	
Chapter 22	
Roles of Accountants in Climate Change Mitigation, Adaptation, and Resilience	374
<i>Odunayo Magret Olarewaju, Durban University of Technology, South Africa</i>	
Chapter 23	
Climate Change Risk and the Performance of South African Banks	387
<i>Babatunde Samuel Lawrence, University of KwaZulu-Natal, South Africa</i>	
<i>Mishelle Doorasamy, University of KwaZulu-Natal, South Africa</i>	

Chapter 24	
Climate Change and Entrepreneurial Financing	399
<i>Ayansola Olatunji Ayandibu, University of Zululand, South Africa</i>	
<i>Makhosazana Faith Vezi-Magigaba, University of Zululand, South Africa</i>	
Chapter 25	
Enterprise Risk Management and Climate Change: Preparing the Financial Sector in Nigeria	411
<i>Olufemi Patrick Adeyeye, Federal University Oye Ekiti, Nigeria</i>	
<i>Adepoju Adeoba Asaolu, Federal University Oye Ekiti, Nigeria</i>	
Chapter 26	
Climate Change Accounting and Value Growth of Financial Institutions in West Africa	431
<i>Haruna Maama, Faculty of Accounting and Informatics, Durban University of Technology, South Africa</i>	
<i>Ferina Marimuthu, Faculty of Accounting and Informatics, Durban University of Technology, South Africa</i>	
Chapter 27	
The Impact of Climate Change on Global Entrepreneurial Activities	446
<i>Mkhothi Tshabalala, University of KwaZulu-Natal, South Africa</i>	
<i>Andrisha Beharry Ramraj, University of KwaZulu-Natal, South Africa</i>	
<i>Jayrusha Ramasamy-Gurayah, University of KwaZulu-Natal, South Africa</i>	
Chapter 28	
Effect of Climate Change on the Manufacturing Sector	463
<i>Zwelihle Wiseman Nzuzza, Durban University of Technology, South Africa</i>	
Compilation of References	477
About the Contributors	562
Index	569

Detailed Table of Contents

Foreword	xxii
-----------------------	------

Preface	xxiv
----------------------	------

Acknowledgment	xxxii
-----------------------------	-------

Chapter 1

Green Sukuk, Islamic Green Financing: A Lesson Learned From Indonesia	1
<i>Khairunnisa Musari, K. H. Ahmad Shiddiq State Islamic University, Indonesia</i>	

As an archipelago with various natural resources and high diversity, Indonesia has great potential to be influenced by the negative impacts of climate change. As part of a responsible and committed global community to realize a low carbon and climate-resilient in the future, many of the programs being undertaken by Indonesia to address climate change mitigation and adaptation also deliver important social benefits. One of them is issuing Green Sukuk. To reflect the implementation of Green Sukuk as Islamic green financing, Indonesia can be a lesson learned. The Green Sukuk issuance marked Indonesia as the world's first country to issue a Sovereign Green Sukuk and another milestone as the first to issue Retail Green Sukuk. This initiative has brought Indonesia got some awards by the global community. Therefore, this chapter addresses key topics to Indonesia's Sovereign Green Sukuk as sustainable green financing by focusing on three issues: (1) Green Sukuk framework, (2) Green Sukuk projects, (3) Green Sukuk report.

Chapter 2

Grey Rhinos and Deep Risk: How Climate Change Will Impact Financial Planning	17
<i>Prince Sarpong, University of the Free State, South Africa</i>	

Discussions on the impact of climate change within the financial services sector have mainly focused on institutional investors. Talk of climate change is all but ignored in financial planning. Financial planning, however, has a profound impact on society and can play a major role in climate change mitigation. Climate change poses an overarching challenge to financial planning and how individuals plan for their long-term goals. The financial services sector which provides the financial instruments for financial planning faces deep uncertainty, which threatens the stability of the sector. The environmental impact of climate change poses an additional risk on health outcomes for individuals. This chapter presents a review of disparate literature to position the risk of climate change as deep risk which has significant implications for financial planning. The chapter outlines how financial planners can prepare themselves and their clients for climate risks while contributing to climate change mitigation as well.

Chapter 3

Revenues of the EU ETS Auctioning and Their Impact on Budgetary Allocation: The Case of Poland	34
--	----

Kamilla Marchewka-Bartkowiak, Poznan University of Economics and Business, Poland
Klaudia Jarno, Poznan University of Economics and Business, Poland

This chapter offers insight into the role of EU ETS auction revenues from the perspective of a public sector and implementation of climate change policy rules. The final part of the chapter presents a detailed analysis of the Poland case in the years 2013-2019. The analyses conducted revealed that the revenues acquired from emission allowances auctioning impacted the state of public finance in Poland to a lesser degree than projected. At the same time, it was also revealed that the currently applied solution in Poland in terms of qualifying revenues from auctioning and spending funds in accordance with the provisions of Directive 2003/87/EC fails to be transparent and does not promote additionality of actions taken.

Chapter 4

SDG 13 and Environmental Governance in the Nigerian Financial Sector.....	52
---	----

Temiloluwa O. Akinsola, Bowen University, Nigeria & University of Johannesburg, South Africa
Michael Olajide Adelowotan, University of Johannesburg, South Africa

This chapter examines how the board of directors of financial organisations and the regulatory bodies have responded to climate change as it has occurred over time, with particular reference to the banking sector in Nigeria. It reflects on the Sustainable Development Goal (SDG) 13, which is about taking urgent action to combat climate change and its impacts by both banks and government regulatory organisations. The chapter is hinged on the triple-bottom line theory and considered various existing international environmental initiatives, and how Nigerian banks have responded to them. The chapter concludes that though a lot has been done by the Nigerian banks to act on initiatives towards climate change, there is more to be done on the part of the board of directors and the regulatory authorities of the listed banks considered.

Chapter 5

Nexus of Climate Change and Sustainable Real Estate	71
---	----

Thabiso Sthembiso Msomi, Durban University of Technology, South Africa
Odunayo Magret Olarewaju, Durban University of Technology, South Africa

This chapter investigates the nexus of climate change and real estate sustainability. Climate change is the topical dramatic swing of the planet's normal climate patterns caused by a spike in emissions of carbon dioxide triggered by human activities. Climate change risk is not being effectively estimated into commercial real estate assessments. Due to high demand for coastal properties, a lopsided share of commercial real estate is vulnerable to climate change risks. Thus, it was concluded that real estate is an essential part of an evolving growth phenomenon and also plays a major role in stimulating economic growth. This makes it important for investors and property owners/dealers to be resilient in combating climate change, and adequate information should be available for investors so they will know the risk attached to their investment.

Chapter 6

Is Current Understanding Adequate for Green Banking Practices in Nepal: A Lesson Learned 84

Niranjan Devkota, Quest International College, Pokhara University, Lalitpur, Nepal

Udaya Raj Paudel, Quest International College, Pokhara University, Lalitpur, Nepal

Ghanashyam Khanal, Tribhuvan University, Kathmandu, Nepal

Going green, in recent days, has been a buzzword for both global banking and financial sectors and for the general public. Green banking as a part of “going green,” referring to the environmentally friendly practices that reduce the carbon footprint by using online services, is a new way of performing the banking businesses considering the clean environmental issues as well as the corporate social responsibility of banks. In this context, this chapter offers an improved understanding of the importance of adopting green banking in the Nepalese banking industry. This chapter uses a mixed-method of analysis – both primary and secondary data were used. The customers and bankers are found to have less awareness regarding the concept of green banking practices in the Nepalese context. In order to promote green banking practices, the banks and governments are required to be aware of the people with the help of some effective policy interventions.

Chapter 7

The Impact of Climate Change on Human Resource Management in the Global Economy 99

Sthokozile Mamba, University of KwaZulu-Natal, South Africa

Andrisha Beharry Ramraj, University of KwaZulu-Natal, South Africa

Climate change has a global impact on everyone in their homes and workplaces. It occurs naturally but is also human-induced. It does more bad than good, especially in the workplace of every industry. Human resource functions play a major role in addressing this issue with management structures, employees, customers, and other stakeholders. The effort of reducing climate change is not an easy task, as many still have no belief that it is actually occurring. This chapter seeks to define the human resource function and climate change concept within a global economy.

Chapter 8

The Relationship Between Climate Change and Financial Stability 118

Joan Nyika, Technical University of Kenya, Kenya

Climate change is the greatest challenge of the modern day with the capacity to destabilize global financial systems and socioeconomic welfare. This chapter explores the uncertainties posed by climate change, its effects on the economy, the risks associated with the phenomenon, and approaches to manage them through risk management. Using documented evidence, climate change is shown to result in gross domestic product reductions; physical, transition, and liability risks that result to systemic financial problems characterized by liquidation of companies, losses for, and closure of financial firms and their intermediaries; and inability of investors to pay debts. Climate risk management is proposed as a solution to adapt to climate change and reduce its associated risks.

Chapter 9

Sustainability and Green Operations Management: Concept, Theory, and Practice 134

Hezekiah Oladimeji, Durban University of Technology, South Africa

Shalini Singh, Durban University of Technology, South Africa

Olayinka Olubukola Afolabi, HANDEL Institute, Nigeria

For over four decades now there has been global concerns emerging from environmental considerations. Sustainability was introduced subsequently as a concept to reconcile these environmental dynamics with other ‘pillars’ of sustainable development (social and economic). These global concerns of the environment indicate the importance of green operations management towards optimal utilisation of organisational resources and sustainable management of the entirety of the systems. To this end, this chapter is aimed at providing a review and discussions on relevant historical literature on sustainability and green operations management.

Chapter 10

Human Resource Development’s Role in Communicating the Risk of Climate Change and Promoting Pro-Environmental Behavioural Changes 144
Kiosha Ramlachan, University of KwaZulu-Natal, South Africa
Andrisha Beharry Ramraj, University of KwaZulu-Natal, South Africa

The notion of climate change has been identified and described as one of the foremost pressing environmental challenges of the current century. A large portion of credible scientists have agreed that climate change threatens irreversible and dangerous consequences on the earth’s ecosystem as a whole. The mitigation of these potential consequences and impacts demands immediate, significant, as well as sustained changes and actions. Given the importance of the above, it is promising that various human resource development (HRD) researchers have taken an eager interest and fascination in environmental issues as well as sustainability.

Chapter 11

Climate Change and the Sustainable Small and Medium-Sized Enterprises 171
Vanessa Gaffar, Universitas Pendidikan Indonesia, Indonesia
Tika Koeswandi, Universitas Pendidikan Indonesia, Indonesia

Small and medium-sized enterprises (SMEs) play an essential role as the key driver in national economic resilience. In developing countries, they contribute to most of the GDP every year. Like a coin with two sides, the rise of SME productivity accidentally caused the increase in global pollution. Now, the SMEs are urged to adjust and set the best strategies to encounter the circumstances. This chapter shares a broader perspective, literature studies, and documentary analysis on the definition and category of SMEs, the involvement of United Nations’ Sustainable Development Goals (SDGs), green practices and strategies, and the issue of building sustainable SMEs in relation with climate change. It is also completed with some case studies in SMEs in Indonesia, Africa, United Kingdom, and many more. The chapters set the tone for the rest of the chapters examining the implications of the issues discussed for climate change and the sustainable financial factor.

Chapter 12

Climate Change and Insurance Business in Developing Economies 190
Olusola Olawale Olarewaju, University of KwaZulu-Natal, South Africa
Bomi Cyril Nomlala, University of KwaZulu-Natal, South Africa

The capacity of insurance systems to reduce immediate losses caused by disasters through the provision of financial security against extreme weather conditions such as hurricanes, tropical cyclones, droughts, and floods avails an opportunity to developing countries for reduction of poverty and steady economic growth. The process of negotiating premium creates a platform for incentives to reduce risk and adapt to

the climate change. There are opportunities for donors to combine resources so as to support the vulnerable communities with measures to reduce risk. In this research work, the scholar examines the process of financing disaster risk in developing countries, insurance of disaster in developing economy, advantages of disaster insurance, cost and risks involved in the insurance business, the concept of adaptation in insurance system, proposal of the Munich climate insurance initiative, the impact of insurance on the reduction of greenhouse gasses, and the globalisation of climate change risk.

Chapter 13

Climate Change and Agricultural Sustainability in Nigeria: An Assessment of the Crop, Forestry, Fisheries, and Livestock Sub-Sectors 202

Edidiong Samuel Akpabio, Trinity University, Nigeria

Valentine Chidozie Udeh, University of Nigeria, Nsukka, Nigeria

Ifeanyi Emmanuel Uzochukwu, University of Nigeria, Nsukka, Nigeria

Nnanna Ephraim Ikeh, University of Nigeria, Nsukka, Nigeria

Ndubuisi Samuel Machebe, University of Nigeria, Nsukka, Nigeria

Climate change and agriculture are intertwined with one having significant impact on the other. Hence, taking cognizance of the relevance of agriculture to man's survival, it has become important to interrogate the effect of climate change on agricultural sustainability. This work therefore embarks on a sub-sectorial assessment of the agricultural sector in the face of rising threats due to climate change. Majorly, the agricultural sector is divided into four sub-sectors.

Chapter 14

Climate Change Lessons for Managers in a Sustainable Economy 229

Joyce Adefunke Ayeni, University of KwaZulu-Natal, South Africa

There exists a close link between the natural environment and the world of work. This emphasizes the dependence of the world of work on environmental factors. The world of work does not exist in isolation but hinges on the ecosystem for survival. Climate change and other kinds of ecological squalor have had adverse effects on jobs, the structure of the organisation, work processes, and work efficiency, and with the increase in global warming, these effects are anticipated to be more noticeable in the approaching decades.

Chapter 15

Climate Change and the Sustainability of Small Businesses in Africa 252

Thabiso Sthembiso Msomi, Durban University of Technology, South Africa

Odunayo Magret Olarewaju, Durban University of Technology, South Africa

This chapter examined the role of climate change in the sustainability of small businesses in Africa, as climate change is a serious challenge. Severe weather events have the ability to interrupt supply chains, making it more difficult for companies to access materials and resources. Climate change is rapidly becoming the most urgent problem facing humanity in the 21st century. Despite rapid efforts in the mitigation of climate change, there are rising global impacts of climate change. Small businesses remain a source of economic growth and social development in African countries irrespective of the global impact of climate change. Thus, African countries should embark on a reasonable transition to a low-carbon, climate-resistant, or environmentally sustainable economy such that small businesses are turned to small green domestic companies.

Chapter 16

Sustainability Tourism and Socio-Economic Development	267
<i>Cigdem Unurlu, Trakya University, Turkey</i>	

The main purpose of this study is to assess sustainable tourism theoretically and practically in a systematic point of view and to provide guidance for future plans and policies related to sustainable tourism. In accordance with this purpose, firstly, the concepts of sustainability, sustainable tourism, and socio-economic development have been discussed, and secondly, the purpose, the principles, and the tools of sustainable tourism were evaluated. Within the scope of sustainable tourism, carrying capacity, environmental impact assessment, and ecological footprint phenomenon were examined.

Chapter 17

Material Flow Cost Accounting (MFCA): A Green Management Tool (GMT) for Hotel Business..	286
<i>Omolola Ayobamidele Arise, University of Kwa-Zulu Natal, South Africa</i>	
<i>Patricia Maureen Shewell, University of Kwa-Zulu Natal, South Africa</i>	

MFCA's potential as a GMT in the hospitality industry has not been well demonstrated. Instead, the manufacturing industry takes the credit for the successful implementation of MFCA. This may be attributed to the industry's inaccurate information on resource consumption and management for strategic internal decision-making. Greening in hotels has predominantly been viewed from customers' perspectives to gain a competitive advantage and improve profits. MFCA is presented in this chapter as a GMT to achieve eco-friendly hotel business practices via informed resource utilization data. Natural resources such as water and energy are gradually becoming scarce commodities with waste generation on the rise and environmental sustainability of the hotel business threatened. Hotels face pressure from the global market to improve their sustainability performance by implementing green practices. In meeting the requirements of sustainable practice, green management's goal focuses on reducing, eliminating, and preventing adverse effects arising from environmental activities.

Chapter 18

Financing Green Electricity in Nigeria for Economic Growth	304
<i>Olufemi Patrick Adeyeye, Federal University Oye Ekiti, Nigeria</i>	
<i>Adekunle Alexander Balogun, Federal University Oye Ekiti, Nigeria</i>	
<i>Oladapo Fapetu, Federal University Oye Ekiti, Nigeria</i>	

Green finance connotes the financial activities designed to aid the recovery of the environment from degradation. In Nigeria, the danger posed by solid waste to the environment is enormous. In particular, refuse collection and disposal mechanisms have not been adequately executed. The urban landscapes in the country are littered with plastics, polythene, and various non-degradable materials. In this chapter, the authors present an efficient way to clean up the Nigerian environment of solid wastes through a waste-to-energy strategy by exploring the green finance options or sources and structure to deliver renewable and clean electricity for Nigeria. The authors concluded by highlighting that green finance is useful for efficient waste management and the generation of green electricity to the Nigerian national grid.

Chapter 19

Green Marketing, Green Management, and Sustainability	316
<i>Ayansola Olatunji Ayandibu, University of Zululand, South Africa</i>	
<i>Khalida Akbar, Durban University of Technology, South Africa</i>	

Green branding marketing techniques have become a popular area of research; however, the use of ‘green’ terms confuses both businesses and customers. This has resulted in consumers becoming more suspicious about the validity of green marketing and green management practices. The objective of this chapter is to outline the concepts of green marketing and green management in detail to clearly demonstrate how they can effectively achieve their aims of ensuring environmental sustainability. An analysis of current extant literature will be explored, and successful green approaches will be used to develop a theoretical framework for green marketing, green management, and sustainability to foster a more climatic conditions-sustainable economy. The literature in this chapter indicated the need for understanding the impact of green marketing and green management on the sustainability of the financial services sector in order to provide recommendations that can direct funding more effectively towards climate-resilient activities and a more climatic conditions-sustainable economy.

Chapter 20

Long-Term Effects of Climate Change on Housing Market analytics in Amaravati, Capital of Andhra Pradesh in India, Using Machine Learning..... 331
Bhimavarapu Usharani, Koneru Lakshmaiah Education Foundation, India

Housing markets are known to be affected by adverse environments (i.e., environmental air pollution incidents affect Indian urban residents). Urban atmosphere quality has changed extensively with PM2.5 and O3 becoming the primary atmosphere indicators of concern because of dense cities in recent years. There is a correlation between the air pollution of Amaravati with the housing market model. When estimating the housing market, the chapter makes use of the extended regression model together with several constant results in conformity with higher rule. However, there is an insignificant affinity including the concentration regarding SO2 and the concentration of O3 appears according to positively increase the housing values. This chapter therefore examines the influence of actual real estate investment over atmosphere characteristics through the use of a sample on 26 prefecture-level cities in India from 2010–2019 through countless econometric models.

Chapter 21

Nexus of Green Management, Green Marketing, Sustainability, and Financial Performance 353
Adenike Oyelola Soogun, Management College of Southern Africa, South Africa

Consumer and organizational awareness of environmental sustainability is ever increasing. In the era of global warming and climate change, organizations need to move away from traditional marketing strategies to green marketing strategies and green management to remain sustainable. The objectives of this chapter are to provide stakeholders with the overview and importance of green marketing, establish the link between green marketing mix and strategic green marketing, and reveal what organizations should focus on in developing green management to remain competitive and profitable. Green marketing strategies activities for financial services were highlighted, and lastly, the authors examined the impact of green management on firm financial performance. The chapter offers a holistic practice and recommendation of going green for both financial services and other businesses. Practical implications for managers were pointed out through commitment to green marketing and management to yield positive outcomes on firm financial performance in the long run.

Chapter 22

Roles of Accountants in Climate Change Mitigation, Adaptation, and Resilience	374
<i>Odunayo Magret Olarewaju, Durban University of Technology, South Africa</i>	

Accountants are in a better position to contribute to initiatives that lead to low-carbon business models that promote economic sustainability by defining climate risk and analysing the strategic, organisational, and financial consequences of the risk mitigation and adaptation. Extensive review and assessment of the roles of accountants in climate change mitigation, adaptation, and resilience was done in this chapter. The chapter concluded by recommending inclusion of a climate change fund in integrated reporting of organisations and intensification of climate change awareness such that every organisation will be aware of how proper accounting can be done on climate change effects. Thereafter, strategies to mitigate, adapt, and be resilient towards it will be initiated.

Chapter 23

Climate Change Risk and the Performance of South African Banks	387
<i>Babatunde Samuel Lawrence, University of KwaZulu-Natal, South Africa</i>	
<i>Mishelle Doorasamy, University of KwaZulu-Natal, South Africa</i>	

The comprehensive climate risk index (CRI) is used to proxy climate change risk in this chapter as an independent variable alongside control variables such as credit risk/nonperforming loan (CRISK), total asset (TA), leverage (LEV), net income margin (NIM), capital adequacy ratio (CAR), yield on earning assets (YEA), and gross domestic product (GDP). Return on assets (ROA) as the response variable was used as proxy for performance of the top six listed South African banks on the Johannesburg stock exchange. Using Stata in a multiple regression technique for the period 2006 to 2019, this chapter concludes that the CRI is negative but not significant enough to impact performance of banks; however, its different individual components such as drought index, rain-waterlogged, etc. could be computed and regressed with other profitability measures to investigate their impact on performance of the banks in future editions of this book.

Chapter 24

Climate Change and Entrepreneurial Financing	399
<i>Ayansola Olatunji Ayandibu, University of Zululand, South Africa</i>	
<i>Makhosazana Faith Vezi-Magigaba, University of Zululand, South Africa</i>	

Entrepreneurs in emerging and developing economies face many challenges curtailing their ability to finance and grow their business ventures. Climate change provides new opportunities for entrepreneurs to gain access to finance and contribute toward more climate-resilient economies. The objective of this chapter is to outline the dimensions of entrepreneurial financing that are sensitive to levels of climate change with emphasis on the financial services sector's role in reacting to these changes. An analysis of current extant literature will be explored, and evidence supporting effective entrepreneurial financing will be used to develop a theoretical framework for climate change and entrepreneurial financing to foster a more climatic conditions-sustainable economy. The literature in this chapter indicated the need for establishing the impact of climate change on entrepreneurial financing in the financial services sector in order to provide recommendations that can direct funding more effectively towards climate-resilient activities and a more climatic conditions-sustainable economy.

Chapter 25

Enterprise Risk Management and Climate Change: Preparing the Financial Sector in Nigeria 411

Olufemi Patrick Adeyeye, Federal University Oye Ekiti, Nigeria

Adepoju Adeoba Asaolu, Federal University Oye Ekiti, Nigeria

The global exposure to climate change-induced risks culminating in the alteration of known environmental order and its debilitating spin effects on the key economic units in which the financial sector plays the intermediation role has raised new levels of consciousness in tackling the phenomenon. To sustain stability of the financial sector and greening of its broad spectrum of activities, there is the need for an enterprise-wide risk approach better delivered through the enterprise risk management (ERM) model. This chapter, therefore, assesses the level of preparation of Nigeria's regulatory bodies and the financial sector on how best to tackle the emerging physical, transitory and indirect risks involved; it also captured the feelers of various stakeholders via responses to the questionnaire. Among other things, the authors recommend the greening of macro-prudential regulations, dynamic monetary policies, and overall framework for the financial sector to reflect the realities of climate change.

Chapter 26

Climate Change Accounting and Value Growth of Financial Institutions in West Africa 431

*Haruna Maama, Faculty of Accounting and Informatics, Durban University of Technology,
South Africa*

*Ferina Marimuthu, Faculty of Accounting and Informatics, Durban University of
Technology, South Africa*

The study investigated the impact of climate change accounting on the value growth of financial institutions in West Africa. The study used 10 years of annual reports of 47 financial institutions in Ghana and Nigeria. The climate change disclosure scores were determined based on the task force's recommended components on climate-related financial disclosure. A panel data regression technique was used for the analysis. The study found a positive and significant relationship between climate change accounting and the value of financial institutions in West Africa. This result implies that the firms' value would improve should they concentrate and enhance their climate change disclosure activities. The findings also revealed that the impact of climate change accounting on the value of financial institutions is positively and significantly higher in countries with stronger investor protection. These findings enable us to expand our understanding of the process of generating value for investors in financial institutions and society, generally.

Chapter 27

The Impact of Climate Change on Global Entrepreneurial Activities..... 446

Mkhothi Tshabalala, University of KwaZulu-Natal, South Africa

Andrisha Beharry Ramraj, University of KwaZulu-Natal, South Africa

Jayrasha Ramasamy-Gurayah, University of KwaZulu-Natal, South Africa

In this era of climate change, there has been urgent calls for entrepreneurs to adopt sustainable business practices. Entrepreneurs need to seek to increase their production efficiency. Entrepreneurs have looked at sustainability as a solution to improve value for society, the environment, and financial gains for their businesses. Businesses around the globe are embracing entrepreneurial business sustainability with the aim of increasing their triple bottom line. Climate change has challenged not only governments across the world but also businesses. Businesses around the globe are embracing entrepreneurial business

sustainability with the aim of increasing their triple bottom line. Climate change has challenged not only governments across the world but also businesses, and as a result, efforts have been made by various stakeholders such as the United Nations to assist countries in mitigating the consequences of climate change on economic, social, and ecological dimensions.

Chapter 28

Effect of Climate Change on the Manufacturing Sector	463
<i>Zwelihle Wiseman Nzuza, Durban University of Technology, South Africa</i>	

The challenge of climate change in the world has hitherto perplexed scholars and professionals, with reports of climate change not sparing the manufacturing sector. All countries are most vulnerable to this threat and will suffer greatly if no action is taken. In the 21st century, scientists have confirmed with great concern the severe weather conditions that are expected to become harsher. The aim of the chapter is to explore the effect of climate change on the manufacturing sector. Literature has been used as a source of secondary data. The effect of climate is examined from five major business strategic positions: productivity, business risk, goods and services, chemicals and minerals, natural resources, and buildings. The chapter also covers the need for manufactures to adapt to climate change with various possible actions that can be taken by the sector against climate impacts on business. Continuous staff and management training and education on climate change is recommended.

Compilation of References	477
About the Contributors	562
Index	569

Foreword

I am an economist who is passionate about the business of teaching and learning. My area of interest has always been related to socioeconomic equity. I am the lead editor of, “A Handbook on the Future of Work & Entrepreneurship for the Underserved.” We believe the body of work is important because of the novel presentation of authentic voices on the future of work.

I met Dr. Odunayo Olarewaju in 2018 at the 8th International Conference on Restructuring of the Global Economy (ROGE), at the Said Business School, University of Oxford, Oxford, United Kingdom. I was a keynote speaker and my topic was “From Good to Great: Shaping a flatten global economy and giving hope to the underserved”. Dr. Olarewaju and I discussed her work after she presented, “Dividend Policy, Agency Cost, and Bank Performance in Selected Sub-Saharan African Countries: The role of Market Risk.” We later discussed our similar paths, albeit from different perspectives; we shared our hopes and dreams of making a difference in the worlds we live in; hers in Africa and mine in America. Over the years we continued to communicate. I read her first book written in 2020 to inspire hope and happiness in others.

We planned to meet again in April 2020 at the International Conference on Business and Economic Development (ICBED)-2020, New York, USA. She was to present her paper “‘Dynamic Panel Investigation of the Determining Factors of Non-Performing Loan in African Lower Middle Income Countries Commercial Banks ‘. We were both disappointed, due to the pandemic, the conference transitioned to a virtual platform, and we could not physically meet. Hence, I was delighted when she asked me to write the Foreword for, *Climate Change and the Sustainable Financial Sector*.

I read the book from the perspective of a board member, and researcher interested in and committed to addressing Environmental Social Justice and Governance (ESG) challenges. What I found was that the body of work addresses issues of diverse stakeholders including labor, management, government and community advocates. Climate change and the future of work impacts everyone from the board room to human resources; it impacts planning for risks and uncertainty both now and in the future.

The book suggests that environmental friendly is no longer a buzz word but rather a preferred workplace and lifestyle of sustainability conscious employees. In the future, organizations may be required to cut jobs that are not environmentally responsible, and prepare workers for green learning.

I was intrigued by the discussion on environmental degradation. Environmental degradation has a significant impact on underserved communities and exasperates poverty, as well as, other socioeconomic inequities. As we seek to quantify, assess and discuss further the issues of environment on our world, we must address the issue of training, re-skilling, and up-skilling those who are becoming the silent majority in the global workforce.

Foreword

Will humanity meet the charge for an inclusive, sustainable, and just society? The research and insights in the following Chapters of Climate Change and the Sustainable Financial Sector may help us find the path.

#thefutureofworkandentrepreneurship

JoAnn Rolle

School of Business, Medgar Evers College, City University of New York (CUNY), USA & Centre for Business and Economic Research, London, UK

Preface

Climate change has brought about a shift in the global financial system such that investors' confidence in the system are gradually being eroded on a large scale. This explains why there has been a debate among financial services provider and regulators on the appropriate way to respond to climate change. As one of the sustainable development goals is on climate actions; dwindling climates undoubtedly has huge impact on nature, sectors and the general society, financial sectors inclusive. Climate change is a systemic risk that has huge impact on the finance industry, as like other sectors of the global economy. Climate change is a major problem, generating both risks and opportunities that will have a direct impact on the economy and the financial sector. In recent years, climate change has threatened both the survival of the financial system and economic development. The growing occurrence of extreme climate events, combined with the imprudent nature of economic growth, has the ability to cause unsustainable levels of harm to the financial sectors. From the other hand, it presents a range of new business challenges. In contrast to the most evident physical risks (for instance, operational effects of extreme weather events or supply shortages induced by water scarcity), companies are vulnerable to transformational risks that arise from the reaction of society to climate change, such as technological change, regulation and markets which can boost the cost of doing business, threaten the profitability of existing goods, or affect the value of the asset. Another climate-related hazard for business sectors is the possible liability for the production of greenhouse gases (GHG). In recent years, several cases have been directly introduced against fossil fuel utilities and producers, holding them liable for the harmful effects of climate change (Burger & Wentz, 2018). Climate change also offers new business opportunities, and it has made research in the context of a sustainable financial sector indispensable. Through charging and allocation of resources, the services of financial sector would play an imperative role in economic growth, in which economies of the world must recognize that they can only progress rapidly towards a climatic conditions-sustainable economy when this function is well performed through the services of financial sector. The reason for this is that the finance sector controls a large pool of capital, out of which substantial part of it could be navigated in the direction of climate resilient activities and low carbon.

ORGANISATION OF THE CHAPTER

The book is valuable to global audience. The published peer reviewed book was edited by Dr Odunayo Margret Olarewaju with contributions from scholars and practitioners across continents. The book which has 28 chapters present relevant issues on climate change and sustainable financial sector. The summary of each chapter contribution is presented below.

Preface

Chapter 1, “Green Sukuk, Islamic Green Financing: A Lesson Learned From Indonesia,” examines Indonesia as an archipelago with various natural resources and high diversity. The author explored the adverse effect of climate change in Indonesia and how it has negatively impacted on the resources and environment. The issue of Green Sukuk as a social benefit to mitigate the devastating effect of climate change was also discussed in this chapter. The author concluded the chapter by explaining that the Green Sukuk initiative positioned Indonesia as the first country in the world to issue a Sovereign Green Sukuk to cushion the effect of climate change.

Chapter 2, “Grey Rhino and Deep Risk: How Climate Change Will Impact Financial Planning,” discusses the impact of climate change on the financial services sector have focusing on institutional investors. The relationship between climate change and financial planning was explored in this chapter. The author further provided insight on how financial planning, has profoundly impacted on society and climate change. The author explained the threat Climate change poses financial planning and how individuals plan for their long-term goals may be adversely affected. This chapter also explored the challenges confronting the financial services sector which provides the financial instruments for financial planning. The author provided suggestion on how financial planners can prepare themselves, and their clients, for climate risks while contributing to climate change mitigation as well.

Chapter 3, “Revenues of the EU ETS Auctioning and Their Impact on Budgetary Allocation: The Case of Poland,” offers an insight into the role of EU ETS auction revenues from the perspective of a public sector and implementation of climate change policy rules. The final part of the chapter presents a detailed analysis of the Poland case in the years 2013-2019. The empirical findings revealed that the revenues acquired from emission allowances auctioning impacted the state of public finance in Poland to a much lesser degree than projected. The implication for practice was based on the empirical findings which further suggested that the currently applied solution in Poland in terms of qualifying revenues from auctioning and spending funds in accordance with the provisions of Directive 2003/87/EC fails to be transparent and does not promote additionality of actions taken.

Chapter 4, “DG 13 and Environmental Governance in the Nigerian Financial Sector,” examines how the board of directors of financial organisations and the regulatory bodies have responded to climate change using the Nigeria’s banking sector as a reference point. The authors reflect on the Sustainable Development Goal (SDG) 13, which suggested the need to take urgent action to combat climate change and its impacts by both banks and government regulatory organisations. The chapter hinged on the triple-bottom line theory by providing detailed explanation on the various existing international environmental initiatives and the response of Nigerian banks to the initiatives. The chapter concludes that though a lot has been done by the Nigerian banks to act on initiatives towards climate change, there is more to be done on the part of the board of directors and the regulatory authorities of the listed banks considered.

Chapter 5, “Nexus of Climate Change and Sustainable Real Estate,” investigates the nexus of climate change and real estate sustainability. The authors suggest that climate change risk is not being effectively estimated into commercial real estate assessments. Due to high demand for coastal properties, a lop-sided share of commercial real estate is vulnerable to climate change risks. Thus, the chapter concluded that real estate is an essential part of an evolving growth phenomenon and plays a major role in stimulating economic growth.

Chapter 6, “Is Current Understanding Adequate for Green Banking Practices in Nepal: A Lesson Learned,” avers that green banking is a part of “going green,” which refers to the environmentally-friendly practices that reduce the carbon footprint by using online services. It was also affirmed that green banking is a new way of performing the banking businesses considering the clean environmental

issues as well as the corporate social responsibility of banks. The study concluded that the customers and bankers have less awareness regarding the concept of green banking practices in the Nepalese context. Furthermore, in order to promote green banking practices, the banks and governments with the help of some effective policy interventions have to take some initiation to increase the awareness of the people regarding green banking performances.

Chapter 7, “The Impact of Climate Change on Human Resource Management in the Global Economy,” delves into the menace of climate change to humanity and the environment. This chapter seeks discusses the human resource function and climate change concept within a global economy. The chapter further explains possible means by which human resources can be managed in relation to climate change in the workplace. The chapter concludes that Climate change also brings about major changes in the workplace through the development of new skills and jobs for the future.

Chapter 8, “The Effects of Climate Change on Financial Stability,” assesses climate change as the greatest challenge of the modern-day with the capacity to destabilize global financial systems and socioeconomic welfare. This chapter explores the uncertainties posed by climate change, its effects on the economy, the risks associated with the phenomenon, and approaches to manage them through risk management. Using documented evidence, climate change is shown to result in gross domestic product reductions, physical, transition, and liability risks that result in systemic financial problems characterized by the liquidation of companies, losses for and closure of financial firms and their intermediaries, and the inability of investors to pay debts. Climate risk management is proposed as a solution to adapt to climate change and reduce its associated risks.

Chapter 9, “Sustainability and Green Operations Management: Concept, Theory, and Practice,” discusses the global concerns emerging from environmental considerations for the past four decades. Sustainability was introduced subsequently as a concept to reconcile these environmental dynamics with other ‘pillars’ of sustainable development (social and economic). The author argues that the global concerns of the environment indicate the importance of green operations management towards optimal utilisation of organisational resources and sustainable management of the entirety of the systems. Detail discussion was presented on sustainability and green operations management in this chapter.

Chapter 10, “Human Resource Development’s Role in Communicating the Risk of Climate Change and Promoting Pro-Environmental Behavioural Changes at Individual and Organisational Levels,” examines climate change as one of the foremost pressing environmental challenges of the twenty-first century. The authors present the views of notable scientists on the irreversible threat of climate and its adverse effect on the ecosystem system.

Chapter 11, “Climate Change and The Sustainable Small and Medium-Sized Enterprises,” explores Small Medium-sized Enterprises (SMEs) as a catalyst for economic growth and the national economic resilience. The author posits that the development of SMEs is like a coin with two sides, in that SMEs productivity has accidentally caused the increase in global pollution. This chapter shares a broader perspective, literature studies, and documentary analysis on the definition and category of SMEs, the involvement of United Nations’ Sustainable Development Goals (SDGs), green practices and strategies, and the issue of building sustainable SMEs in relation with climate change issue. The concluded with a detailed discussion on the implications of climate change and the sustainable financial factor.

Chapter 12, “Climate Change and Insurance Business in Developing Economy,” assesses the capacity of insurance system to reduce immediate losses caused by disaster through the provision of financial security against extreme weather conditions such as hurricanes, tropical cyclones, droughts, and flood. The authors suggests that the process of negotiating premium creates a platform for incentives to reduce risk

Preface

and adapt to the climate change. The opportunities for donors to combine resources so as to support the vulnerable communities with measures to reduce risk was equally discussed in this chapter. The authors further examine the process of financing disaster risk in developing countries, insurance of disaster in developing economy, advantages of disaster insurance, cost and risks involved in the insurance business, the concept of adaptation in insurance system, proposal of the Munich climate insurance initiative, the impact of insurance on the reduction of greenhouse gas and the globalisation of climate change risk.

Chapter 13, “Climate Change and Agricultural Sustainability in Nigeria: A Sub-Sectorial Analysis,” embarks on a holistic examination of the effects of climate change on sustainability of the above- agricultural sub-sectors in Nigeria. The chapter also looks at the impacts of climate change on agriculture and the adaptation strategies that can be deployed in reducing vulnerabilities of the sub-sectors to climate change. The authors adopt a quantitative approach to unearth the issues under discourse. It extracts data from secondary sources such as books, journal papers, policy briefs, conference proceedings and monographs amongst others. The quantitative method entails the adoption of descriptive and inferential statistics to draw conclusions on variables of interest. The chapter is double edged in nature because it does not only discuss the causes of the menace of climate change, but it also proffers solutions to it.

Chapter 14, “Climate Change Lessons for Managers in a Sustainable Economy,” explores the link between the natural environment and the world of work. This chapter emphasizes the dependence of the world of work on environmental factors. The world of work does not exist in isolation but hinges on the ecosystem for survival. The author suggests that climate change and other kinds of ecological squalor have had adverse effects on jobs, the structure of the organisation, work processes, and work efficiency, and with the increase in global warming, these effects are anticipated to be more noticeable in the approaching decades.

Chapter 15, “Climate Change and the Sustainability of Small Businesses in Africa,” examines the role of climate change in the sustainability of small businesses in Africa. The author argues that, despite the rapid efforts in the mitigation of climate change, there are rising global impacts of climate change. Small businesses remain a source of economic growth and social development in African countries irrespective of the global impact of climate change. This study recommended that African countries should embark on a reasonable transition to a low-carbon, climate-resistant or environmentally sustainable economy such that small businesses are turned to small green domestic companies.

Chapter 16, “Sustainability Tourism and Socio-Economic Development,” assesses sustainable tourism using theoretically and practically lens. The impact of climate change on the tourism and hospitality industry was discussed in this chapter. The chapter further explored the concept of ‘green hotel’ and the principles of sustainable tourism from a socio-economic perspective. Within the scope of sustainable tourism, carrying capacity, environmental impact assessment and ecological footprint phenomenon were examined.

Chapter 17, “Material Flow Cost Accounting (MFCA): A Green Management Tool (GMT) for Hotel Business,” examines MFCA’s potential as a GMT in the hospitality industry. Greening in hotels has predominantly been viewed from customers’ perspectives to gain a competitive advantage and improve profits. MFCA is presented in this chapter as a GMT to achieve eco-friendly hotel business practices via informed resource utilization data. Natural resources such as water and energy are gradually becoming scarce commodities, waste generation on the rise, and environmental sustainability of the hotel business threatened. Hotels face pressure from the global market to improve their sustainability performance by implementing green practices. In meeting the requirements of sustainable practice, green management’s goal focuses on reducing, eliminating, and preventing adverse effects arising from environmental activities.

Chapter 18, “Financing Green Electricity in Nigeria for Economic Growth,” discusses Green finance as the financial activities designed to aid the recovery of the environment from degradation. In Nigeria, the danger posed by solid waste to the environment is enormous. The authors posit that, refuse collection and disposal mechanisms have not been adequately executed. The urban landscapes in the country are littered with plastics, polythene, and various non-degradable materials. In this chapter, the authors present an efficient way to clean up the Nigerian environment of solid wastes through a waste-to-energy strategy by exploring the green finance options or sources, and structure to deliver renewable and clean electricity for Nigeria. The authors concluded by highlighting that green finance is useful for efficient waste management and the generation of green electricity to the Nigerian national grid.

Chapter 19, “Green Marketing, Green Management, and Sustainability,” assesses Green marketing techniques as an area of research that demonstrate how firms in the financial services sector can effectively achieve their aims of ensuring environmental sustainability. An extensive review of literature was conducted to establish the strategic basis for green marketing, green management, and development in order to promote a more climate-sustained economy. The chapter suggested the need to consider the effects of green marketing and green management on the sustainability of the financial services industry in order to include guidance that would more efficiently direct funding for climate-resilient practices, and a more sustainable economy.

Chapter 20, “Long-Term Effects of Climate Change on Housing Market Analytics in Amaravati Capital of Andhra Pradesh in India Using Machine Learning,” explores the adverse effect of climate change on the housing market. Urban atmosphere quality has been impacted extensively by PM2.5 and O₃. This study established a correlation between the air pollution of Amaravati and the housing market model. When estimating the housing market, this chapter makes use of the extended regression model together with several constant results in conformity with the rule of thumb.

Chapter 21, “Nexus of Green Management, Green Marketing, Sustainability, and Financial Performance,” assesses consumer and organization’s awareness of environmental sustainability. In the era of global warming and climate change, organizations need to move away from traditional marketing strategies to green marketing strategies and green management to remain sustainable. This chapter discusses the importance of green marketing, the link between green marketing mix and strategic green marketing, and organization roles in developing green management to remain competitive and profitable. The chapter offers recommendation on the benefit of adopting sustainable financial services. Practical implications for managers were pointed out through commitment to green marketing and management to yield positive outcomes on firms’ financial performance in the long run.

Chapter 22, “Roles of Accountants in Climate Change Mitigation, Adaptation, and Resilience,” explores the position of accountants in fostering low-carbon business models and economic sustainability. Extensive review and assessment of the roles of accountants in climate change mitigation, adaptation and resilience was done in this chapter. The chapter concluded by recommending inclusion of a climate change fund in integrated reporting of organisations and intensification of climate change awareness such that every organisation will be aware of how proper accounting can be done on climate change effects. Thereafter, strategies to mitigate, adapt and be resilient towards it will be initiated.

Chapter 23, “Climate Change Risk and the Performance of South African Banks,” examines the comprehensive climate risk index (CRI) in relation to other variables such as credit risk/nonperforming loan (CRISK), total asset (TA), leverage (LEV), net income margin (NIM), capital adequacy ratio (CAR), yield on earning assets (YEA) and gross domestic product (GDP). Return on assets (ROA), as the response variable, was used as a proxy for the performance of the top six banks on the Johannesburg

Preface

stock exchange. Stata, a multiple regression technique for the period 2006 to 2019, was used to determine the impact of ROA on the comprehensive climate risk change index in the top five commercial banks in South Africa. The study found that CRI has no impact on the performance of banks, listed on the JSE. This chapter concludes that the relationship between CRI and bank performance is negative but not significant to impact bank performance.

Chapter 24, “Climate Change and Entrepreneurial Financing,” discusses the challenges faces by entrepreneurs in the context of emerging and developing economies. In light of this, climate change provides new opportunities for entrepreneurs to gain access to finance and contribute toward more climate-resilient economies. An analysis of current extant literature was explored to develop a theoretical framework for climate change and entrepreneurial financing to foster a more climatic conditions-sustainable economy. The authors provided recommendation on the need for establishing entrepreneurial financing in the financial services sector.

Chapter 25, “Enterprise Risk Management and Climate Change: Preparing the Financial Sector in Nigeria,” explores the global exposure to climate change-induced risks which culminate in the alteration of known environmental order and its debilitating spin effects on the key economic units. To sustain stability of the financial sector and greening of its broad spectrum of activities; there is the need for an enterprise-wide risk approach better delivered through the enterprise risk management (ERM) model. The authors assess the level of preparation of Nigeria’s regulatory bodies and the financial sector on how best to tackle the emerging physical, transitory, and indirect risks involved; it also captured the feelers of various stakeholders via responses to survey questionnaire. Among other things, authors recommend the greening of macro-prudential regulations, dynamic monetary policies, and overall framework for the financial sector to reflect the realities of climate change.

Chapter 26, “Climate Change Accounting and Value Growth of Financial Institutions in West Africa,” investigated the impact of climate change accounting on the value growth of financial institutions in West Africa. The study used ten years of annual reports of forty-seven financial institutions in Ghana and Nigeria. The climate change disclosure scores were determined based on the Task Force’s recommended components on Climate-related Financial Disclosure. A panel data regression technique was used for the analysis. The study found a positive and significant relationship between climate change accounting and the value of financial institutions in West Africa. The implications for regulatory and policy development in the financial sector in West Africa was discussed in this chapter.

Chapter 27, “The Impact of Climate Change on Global Entrepreneurial Activities,” assesses climate change the need for entrepreneurs to adopt sustainable business practices. The authors explain the need for entrepreneurs to seek to increase their production efficiency. The study found that, environmental concern pressure applied by international organisations on countries indirectly affects global entrepreneurial activities., This study further revealed that climate change also directly disrupts entrepreneurial global supply chain processes.

Chapter 28, “Effect of Climate Change on Manufacturing Sector,” examines the challenge of climate change with reference to the global manufacturing sector. The author affirmed that all countries are most vulnerable to the threat posed by climate change and will great danger if no action is taken. The effect of climate was examined from five major business strategic positions namely, productivity, business risk, goods and services, chemicals and minerals, natural resources and buildings. Extant literature was used as a source of secondary data. The chapter suggested for manufactures to adapt to climate change with various possible actions that can be taken by the sector against climate impacts on business.

REFERENCES

Burger, M., & Wentz, J. (2018). Holding fossil fuel companies accountable for their contribution to climate change: Where does the law stand? *Bulletin of the Atomic Scientists*, 74(6), 397–403. doi:10.1080/00963402.2018.1533217

Acknowledgment

We express our profound gratitude to our friends and colleagues globally from various discipline who contributed chapters and assisted us in ensuring that the book titled climate change and the sustainable financial sector is a reality.

Moreover, we are very grateful for the constructive criticisms, evaluations and suggestions received from the reviewers and editorial advisory board members, which momentarily assisted in bringing out the best from each chapter contributed to the book.

Likewise, we sincerely appreciate the unrelenting support, effort and guidance of the publisher throughout the stages of this publication.

We are indebted to our immediate families; spouses and children for their sacrifices during the execution of this project. You are loved and much appreciated.

Thank you all.

Odunayo Magret Olarewaju
Durban University of Technology, South Africa

Idris Olayiwola Ganiyu
University of KwaZulu-Natal, South Africa

Chapter 1

Green Sukuk, Islamic Green Financing: A Lesson Learned From Indonesia

Khairunnisa Musari

 <https://orcid.org/0000-0003-0525-9903>

K. H. Ahmad Shiddiq State Islamic University, Indonesia

ABSTRACT

As an archipelago with various natural resources and high diversity, Indonesia has great potential to be influenced by the negative impacts of climate change. As part of a responsible and committed global community to realize a low carbon and climate-resilient in the future, many of the programs being undertaken by Indonesia to address climate change mitigation and adaption also deliver important social benefits. One of them is issuing Green Sukuk. To reflect the implementation of Green Sukuk as Islamic green financing, Indonesia can be a lesson learned. The Green Sukuk issuance marked Indonesia as the world's first country to issue a Sovereign Green Sukuk and another milestone as the first to issue Retail Green Sukuk. This initiative has brought Indonesia got some awards by the global community. Therefore, this chapter addresses key topics to Indonesia's Sovereign Green Sukuk as sustainable green financing by focusing on three issues: (1) Green Sukuk framework, (2) Green Sukuk projects, (3) Green Sukuk report.

BACKGROUND

Indonesia is home to 10% of the world's tropical forests and 36% of the world's tropical peatlands. As the largest archipelagic country in the world consisting of more than 17,508 islands that has various natural resources and high diversity, Indonesia has great potential to be influenced by the negative impacts of climate change. Climate change presents significant risks to health, livelihoods, food security, water supply, energy, human security and economic growth. Furthermore, Indonesia's position close to the global ocean conveyor system makes it particularly vulnerable to natural disasters that will likely to be exacerbated by climate change.

DOI: 10.4018/978-1-7998-7967-1.ch001

Therefore, Indonesia considers climate mitigation and adaptation efforts as an integrated concept that is essential for building resilience in safeguarding food, water, and energy resources. Its extensive tropical landscape and seascape with high biodiversity, high carbon stock values, and energy and mineral resources are all contributing factors for this country to be at the forefront of climate action and environmental protection. As one of the first to ratify the Paris Agreement and has shown ambition in putting forward its Nationally Determined Contribution (NDC), by 2030, Indonesia pledges to reduce greenhouse gases emissions 29% up to 41% and to improve its climate resilience.

Absolutely, Indonesia is facing challenges in maintaining its status as one of the megadiverse countries in the world due to threats such as deforestation. Indonesia's strong commitment to the environment and climate change issues, as well as biodiversity, could be achieved through comprehensive and coherent policy development, institutional strengthening, technology innovation, social-cultural approaches, and improved financial and funding mechanisms. Muktiyanto (2019), Buana and Musari (2020), Musari (2020a) admitted that there is a financial gap between the funding needs and funding sources currently available to support the Government of Indonesia (GoI) commitment to finance climate change activities.

Globally, UN ESCAP (2014), Tamura and Yu (2015), Yu (2016), Puig, Olhoff, Bee, Dickson, and Alverson (Eds.) (2016), SC & World Bank (2019) highlighted also that a goal for climate change adaptation represents a challenge with local, national, and international dimensions. Developing countries have to find strategies to scale up domestic climate finance through alternative financial sources that can bridge the finance gaps and to strengthen market incentives and financing access for sustainable energy investments and climate mitigation and adaptation. The financial sector has an integral role to play given the scale of the financial resources required to support climate mitigation and adaptation initiatives. Given the strain on government budgets, both public and private sector finance have to be involved through innovative instruments to ensure that finance corresponds to the priorities and needs of recipient countries and communities, and results in sustainable outcomes.

In order to tackle climate change and greenhouse gas emissions, one of the instruments issued by the GoI is green sukuk. Moghul and Safar-Aly (2014), Alam, Duygun, and Ariss (2016), Morea and Poggi (2017), World Bank (2017), Ramadhan and Wiryaningsih (2020), Wahab and Naim (2020), Musari (2020d) recognized that green sukuk as investment instrument for sustainable development have become increasingly popular in the recent past as part of socially responsible or impact investment strategies of countries and companies alike. Referring to IMF (2015), sukuk might fulfil the funding gap for infrastructure. Sukuk is considered as suitable to finance the infrastructure because of their risk-sharing features, therewith supporting to fill financing gaps in developing countries.

Long before, Kahf (1997) has put forward that sukuk potentially become a public sector financing instrument. Musari (2009a, 2019) and Sriyana (2009) also mentioned the potency of sukuk for fiscal sustainability over the long term in managing public finance. Ismal and Musari (2009a, 2009b, 2009c) even argued that sukuk is a better financing instrument than debt or loan. The thesis of Ismal (2010) attested that sukuk can be an instrument for managing liquidity and portfolio. The thesis by Musari (2013a, 2013b) also concluded that sukuk has a significant positive influence on the independence of state budget if be used for working capital of industry and infrastructure development as well as a substitute for foreign debt.

Apart from funding issues, efforts to tackle climate change are also experiencing problems in terms of the institutional arrangements gap. UNFCCC (2013) concluded some of the trends and gaps that on regional perspectives in existing institutional arrangements in relation to a set of following key cross-cutting issues: (1) Coordination, coherence and synergies among stakeholders; (2) Risk management

Green Sukuk, Islamic Green Financing

continuum; (3) Financial institutional arrangements; (4) Data and knowledge sharing. Previously, Willems and Baumert (2003) reminded that institutional arrangements are needed to develop a climate strategy that has the backing of various national interests in finance, trade, energy, national security, represented by powerful national institutions. Some specific resources can also be allocated for developing the necessary institutional arrangements for climate policy.

Therefore, when most of the gaps in institutional arrangements to tackle climate change occur in developing countries, Indonesia's Green Sukuk as the world's first Sovereign Green Sukuk can provide lessons also as a national collaborative effort to tackle climate change. Hence, this chapter purposes to address key topics to green financing from Indonesia in form of Sovereign Green Sukuk by focusing on three issues.

First, Green Framework. This part will describe the Green Sukuk Framework which is developed by the GoI under which it plans to finance and/or refinance Eligible Green Sectors via the issuance of Green Sukuk. Generally, this framework will explain: (1) Use of Proceeds; (2) Process for Project Evaluation and Selection; (3) Management of Proceeds; (4) Reporting.

Second, Green Project. This part will describe the featured projects which are funded by Green Sukuk. There will be a list and brief description of the projects to which Green Sukuk proceeds have been allocated and the amount of Green Sukuk proceeds allocated to such projects. Eligible green projects refer to projects of Eligible Green Sectors which promote the transition to low-emission economy and climate resilient growth, including climate mitigation, adaptation, and biodiversity in accordance with the criteria and process set out in this framework.

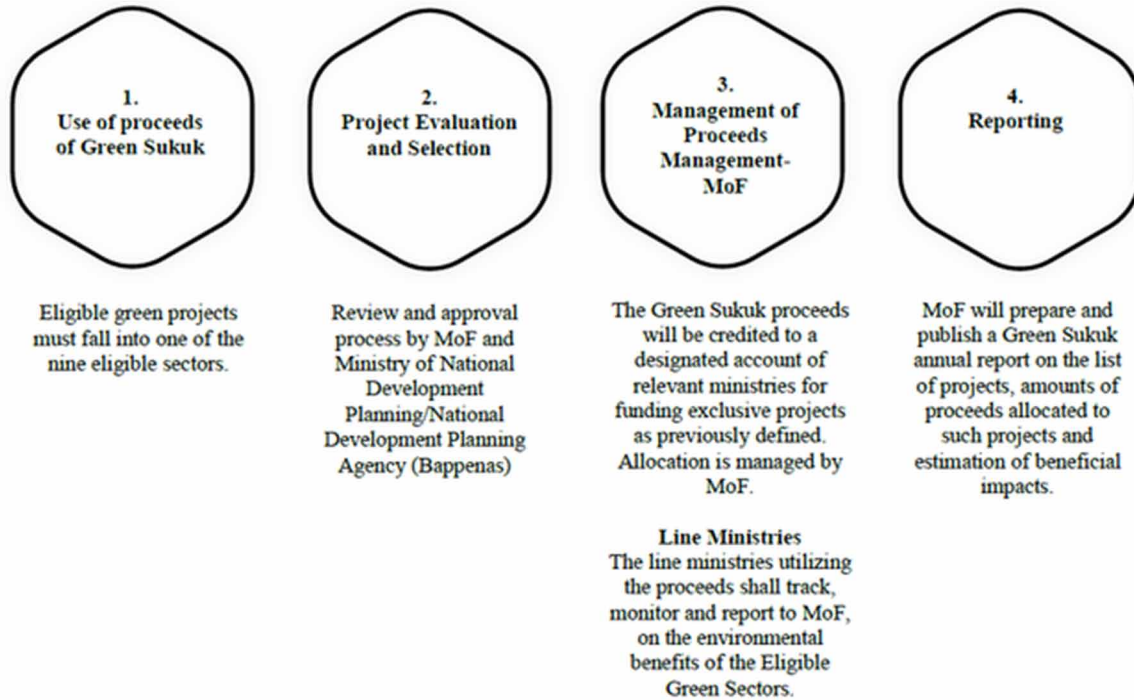
Third, Green Report. To deliver full transparency and accountability on the use of proceeds of the Green Sukuk issuance, GoI represented by the Ministry of Finance (MoF) will publish a Green Sukuk Report annually. The report will contain an estimation of the beneficial impact arising from the implementation of Eligible Green Sectors. The report includes the measures of the reduction in greenhouse gas emissions, reduction in resource consumption, the number of parties that benefit from projects funded, which goal of sustainable development goals (SDGs) have reached, and other appropriate measures taking into account the nature of the project.

GREEN SUKUK FRAMEWORK

Since 2015, the GoI has been supporting national efforts to integrate climate change into planning and budgeting systems and developed a budget tagging mechanism to track the national budget that correlates with climate change impacts. The result of this budget tagging exercise has enabled the GoI to better map the green financing needs across sectors. Following the completion of Indonesia's Green Sukuk Framework, the GoI has been able to successfully issue Sovereign Green Sukuk to global market in March 2018. The Indonesia's Green Sukuk Framework as shown the following Figure 1.

Furthermore, the proceeds of Green Sukuk will be used exclusively to finance or refinance expenditure directly related to Eligible Green Sectors. Eligible Green Sectors refer to projects which promote the transition to low-emission economy and climate resilient growth, including climate mitigation, adaptation, and biodiversity in accordance with the criteria and process set out in this framework.

Figure 1. Indonesia's green sukuk framework
 Source: MoF & UNDP Indonesia (2018), Hendranata (2018), Modified



Use of Proceeds

Referring to Green Sukuk, Allocation and Impact Report (MoF, 2020), the green projects funded by Green Sukuk are selected from tagged projects that fall into one of the nine Eligible Green Sectors under the framework. MoF selects projects that are timeline consistent with the tenure of the Green Sukuk. The environmental benefits of each project are accessed by the individual ministries together with the Ministry of National Development Planning/Bappenas, and are validated by the Ministry of Environment and Forestry to be consistent with Indonesia's NDC.

The Indonesia's Green Sukuk Framework has received a second opinion from the Centre for International Climate Research (CICERO) and is awarded medium green shading, which allows the possibility of light, medium and dark green project types. This shade also shows that eligible listed projects are representing the country efforts towards the long-term vision in carbon emission reduction, but not there yet. According to this Framework, the nine Eligible Green Sectors to receive the proceeds of green sukuk as shown Table 1.

For the avoidance of doubt, in any case, the Eligible Green Sectors will exclude: (1) New fossil fuel based electric power generation capacity and expenditure related to the improvement in the efficiency of fossil fuel based electric power generation; (2) Large scale hydropower plants (>30 megawatt capacity); and (3) Nuclear and nuclear-related assets.

Green Sukuk, Islamic Green Financing

Table 1. The nine eligible green sectors

Eligible Green Sectors	Eligible Green Projects
1. Renewable Energy	<ul style="list-style-type: none"> • Generation and transmission of energy from renewable energy sources: include offshore and onshore wind, solar, tidal, hydropower, biomass and geothermal. • Research and development of products or technology for renewable energy generation, include turbines and solar panels.
2. Sustainable Management of Natural Resource	<ul style="list-style-type: none"> • Sustainable management of natural resources, which substantially avoids or reduces carbon loss/ increases carbon sequestration (through planting of new forest areas, and/or replanting of degraded areas, the use of drought / flood / temperature resistant species). • Habitat and biodiversity conservation (through sustainable management of land use change, sustainable management of agriculture/fisheries/ forestry, protection of coastal, and marine environments, pest management.
3. Energy Efficiency	<ul style="list-style-type: none"> • Improvement of the energy efficiency of infrastructure, which results in an energy consumption of at least 10% below the average national energy consumption of an equivalent consumption of at least 10% below the average national energy consumption of an equivalent.
3. Energy Efficiency	Research and development of products or technology and their implementation that reduces energy consumption of underlying asset, technology, product or system(s); including LED lights, improved chillers, improved lighting technology, and reduced power usage in manufacturing operations.
4. Green Tourism	<ul style="list-style-type: none"> • Developing new tourism areas in line with Green Tourism Principles. • Optimization of supporting infrastructure to support sustainable tourism (i.e. water treatment, energy efficiency). • Developing tourism resiliency against climate change risk.
5. Resilience to Climate Change for Highly Vulnerable Areas and Sectors/Disaster Risk Reduction	<ul style="list-style-type: none"> • Research leading to technology innovation with sustainability benefits. • Food security. • Flood mitigation. • Drought management. • Public health management.
6. Green Buildings	Developing green buildings in line with Greenship developed by Green Building Council (GBC) Indonesia, which contains six categories: Appropriate Site Development, Energy Efficiency and Conservation, Water Conservation, Material & Resources Cycle, Air Quality & Leisure Air (Water Indoor Health & Comfort), Building & Environment Management.
7. Sustainable Transport	<ul style="list-style-type: none"> • Developing clean transportation systems. • Transportation network upgrade to higher climate resilient design standards.
8. Sustainable Agriculture	<ul style="list-style-type: none"> • Developing sustainable agriculture management and methods, such as organic farming, less pesticides, research and development on climate resilient seeds, and energy efficient on agriculture. • Subsidy mechanism for agriculture insurance.
9. Waste to Energy & Waste Management	<ul style="list-style-type: none"> • Improving waste management. • Transforming waste to renewable energy source. • Rehabilitation of landfill areas.

Source: MoF & UNDP Indonesia (2018), MoF (2019)

Process for Project Evaluation and Selection

The GoI represented by the Ministry of National Development Planning/Bappenas, and the MoF will review and approve projects/budget allocation/subsidies to be included in the State Budget. In 2015, the Republic of Indonesia introduced Budget Tagging Process, a system for tagging of ministry budgets, to identify expenditures on projects that deliver specified climate change benefits in accordance with the Republic of Indonesia's climate objectives.

The Budget Tagging Process is an integrated process involving the individual ministries responsible for the individual projects as well the MoF. The MoF will select the tagged projects that: (1) Fall into

one or more of the Eligible Green Sectors; (2) Have a project development timeline consistent with the tenor of the applicable Green Sukuk and funded by the use of proceeds of Green Sukuk. The MoF will maintain notes and records of all eligible green projects reviewed and to be funded by the Use of Proceeds of each Green Sukuk issued.

The Budget Tagging Process by the GoI was developed with the support of the United Nations Development Programme (UNDP) and involves a detailed assessment of the climate benefits of projects undertaken by Line Ministries. At the initial stage, the Budget Tagging Process covers climate change mitigation, involving 6 Line Ministries, i.e. Ministry of Agriculture, Ministry of Energy and Mineral Resources, Ministry of Transportation, Ministry of Industry, Ministry of Environment and Forestry, and Ministry of Public Works and Housing based on key performance indicators of project output.

In 2018, the Budget Tagging Process is expanded to cover climate change mitigation and adaptation, involving 17 Line Ministries, i.e. Ministry of Agriculture, Ministry of Environment and Forestry, Ministry of Maritime Affairs and Fisheries, Ministry of Energy and Mineral Resources, Ministry of Transportation, Ministry of Public Works and Housing, Ministry of Health, Ministry of Home Affairs, Ministry of Agrarian Affairs and Spatial Planning/National Land Agency, Ministry of Law and Human Rights, Indonesian Institute of Sciences, National Institute of Aeronautics and Space, Geospatial Information Board, Assessment and Application of Technology Agency, Indonesian Agency for Meteorology, Climatology and Geophysics, Indonesian Central Board of Statistics, and Ministry of National Development Planning/Bappenas. Currently Indonesia is in the process to expand the Budget Tagging Process to biodiversity under Biodiversity Financing Program.

Overall, the process for project evaluation and selection thru Budget Tagging Process is summarized in the following Figure 2.

Management of Proceeds

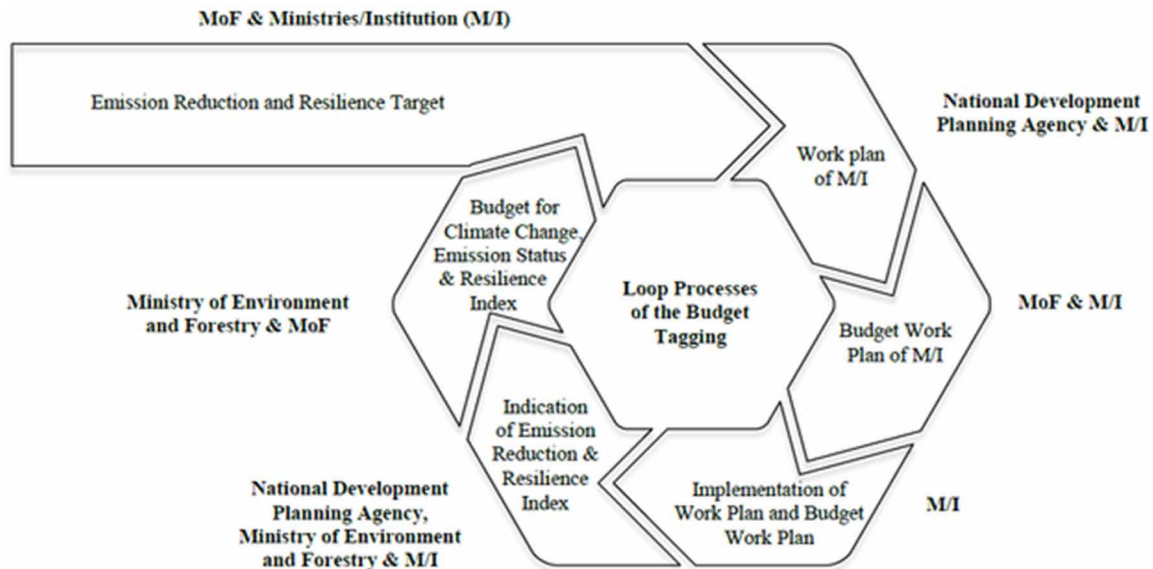
The proceeds of Green Sukuk will be managed within the GoI's general account in accordance with sound and prudent treasury management policy. Upon request from the Line Ministries, the Green Sukuk proceeds will be credited to a designated account of the relevant ministries for funding exclusively projects as defined in the Framework. Pending application to eligible green project proceeds will be held in cash in the GoI's general account at Bank Indonesia.

Then, the respective ministries utilising the proceeds will track and monitor, then report to the MoF about the environmental benefits of the eligible green projects in their portfolio which are funded by Green Sukuk proceeds. A Green Sukuk allocation register will be established to record the allocation of each Green Sukuk proceeds. The register will contain information with comprising: (1) Details of Green Sukuk: international securities identification number (ISIN), pricing date, maturity date, etc; (2) List of eligible green projects with information including: Summary of projects details, expected climate and/or environmental impacts of eligible projects, amount of proceeds allocated to each eligible projects, aggregate amount of proceeds of Green Sukuk allocated to eligible projects, remaining balance of unallocated proceeds, other necessary information.

Green Sukuk, Islamic Green Financing

Figure 2. The budget tagging process

Source: MoF & UNDP Indonesia (2018), Modified



Reporting

In this phase, the GoI represented by the MoF will prepare and publish an annual Green Sukuk report on the management and the use of proceeds as well as the impact on the environment on the date falling no more than one year after the inaugural Green Sukuk issuance. The annual report will contain at least: (1) A list and brief description of the projects to which Green Sukuk proceeds have been allocated; (2) The amount of Green Sukuk proceeds allocated to such projects; (3) An estimation of the beneficial impact arising from the implementation of eligible green projects. Reporting is expected to include measures of the reduction in greenhouse gas emissions, reduction in resource consumption, the number of parties that benefit from projects funded and other appropriate measures taking into account the nature of the project. The report will be published on the MoF website.

In order to do continuous improvement for better issuance processes in the future for preparing the annual report, Hendranata (2018) mentioned what have to do: (1) Coordination with line technical ministries; (2) Developed indicators for monitoring and reporting, outputs and its environment impacts; (3) Find the second opinion/external independent auditor.

GREEN SUKUK PROJECTS

The Green Sukuk was issued by Perusahaan Penerbit SBSN Indonesia (PPSI) III, a legal entity established by the GoI for the purpose of issuing sharia compliant securities in foreign currencies in the international markets. On 1 March 2018, the GoI debuted the Global Green Sukuk with a USD1.25 billion offering. The transaction represents the world's first Sovereign Green Sukuk issuance and the first ever sovereign green offering in USD in either sukuk or conventional formats. Then, the GoI issued the second Global

Green Sukuk in February 2019 totaling USD750 million. In June 2020, the GoI continued to issue the sustainable financing for climate change by dedicating the 5-year tranche as the third Global Green Sukuk. The transaction is in line with the GoI’s financial objectives including financing its fiscal expenditures to handle the impact of Covid-19 pandemic as well as strengthening Indonesia’s position in the global Islamic market and supporting the development of Islamic financing in Asia region.

Additionally, Retail Green Sukuk series ST006 was issued in November 2019 and became the first Retail Green Sukuk in the world. In November 2020, Retail Green Sukuk with a series ST007 was issued. All the results of the Retail Green Sukuk issuance are used to finance environmentally friendly projects, both refinancing and new financing. DPS (2020b) noticed that one of the achievements of the ST007 was to become the Retail Savings Sukuk series with the largest sales nominal and the largest number of investors in the history of the Savings Sukuk issuance. Interestingly, investors of this investment instrument were Millennials with 56.71% while the largest order volume of 43.34% were Baby Boomers with IDR2.349 trillion. This figure in percentage terms is not far from ST006 which reached 43.20% .

Table 2 shows the executive summary of Indonesia’s Sovereign Green Sukuk, including Global Green Sukuk and Retail Green Sukuk during 2018-2020.

Table 2. The executive summary of Indonesia’s Sovereign Green Sukuk

	2018	2019		2020	
	Global Green Sukuk	Global Green Sukuk	Retail Green Sukuk	Global Green Sukuk	Retail Green Sukuk
Instrument	USD Wakala Trust Certificate	USD Wakala Trust Certificate	ST006	USD Wakala Trust Certificate	ST007
Total Amount	USD1.25 billion (~IDR16.75 trillion)	USD754 million (~IDR11.25 trillion)	IDR1,459.88 billion	USD750 million	IDR5,421.257billion
Total/Origin of Investors	32% to Islamic, Malaysia, and Middle East investors, 10% to Indonesia, 25% to Asia (excluded Indonesia), 18% to US, and 15% to Europe.	29% to Islamic, Malaysia, and Middle East investors, 23% to US, 22% to Europe.	7,735 Investors	32% to Islamic and Middle East investors, 5% to Indonesia, 40% to Asia (excluded Indonesia), 12% to US, and 11% to Europe.	16,992 Investors
Yield	3.75%	3.9%	6.75% (Floating with Floor)	2.3%	5.50% (Floating with Floor)
Tenor	5 Years	5.5 Years	2 Years	5 Years	2 Years
Listing	Singapore Stock Exchange and NASDAQ Dubai		Singapore Stock Exchange and NASDAQ Dubai	-	Singapore Stock Exchange and NASDAQ Dubai

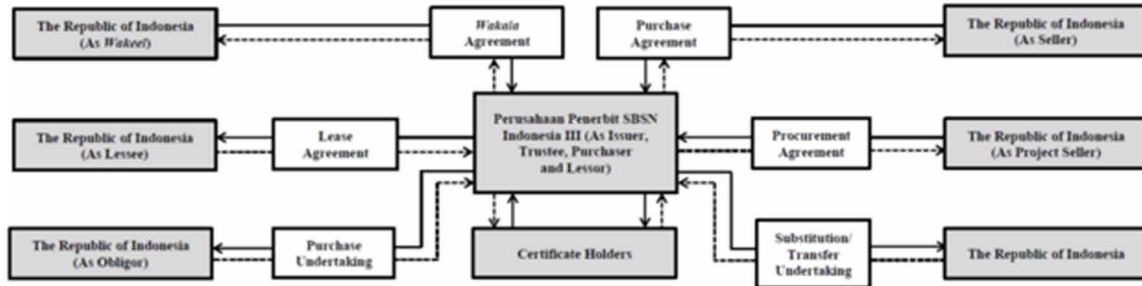
Source: DPS (2019a, 2019b, 2019c), DPS (2020a, 2020b), MoF (2019), MoF (2020), Gumelar (2019)

Each issuance of Global Green Sukuk comprised of 51% refinancing existing projects and 49% financing new projects. Each issuance also was structured based on the Islamic principles of wakala which assets under issuance consist of: (1) State-owned assets including land and buildings (51%); and (2) Project assets which are under construction or to be constructed (49%). The *wakala* sukuk structure is shown by the following Figure 3.

Green Sukuk, Islamic Green Financing

Figure 3. Wakala Sukuk structure

Source: MoF (2020)



Furthermore, list of refinancing and financing project of 2019 funded by the Global Green Sukuk issuance is shown the following Table 3. There were nine refinancing projects of five Eligible Green Sectors and five financing projects of four Eligible Green Sectors allocated by Global Green Sukuk in 2019. These projects also confirmed that there are no changes to the allocation of the 2018 issuance.

In order to assure that the investment made by the Green Sukuk generates sustainable environmental and/or social outcomes alongside financial returns, the GoI has committed to transparent reporting of the amounts of proceeds allocated and employed, social and environmental impacts, and the headway of the green projects assigned as underlying assets. Therefore, the last phase of Green Sukuk issuance process is reporting.

GREEN SUKUK REPORT

The GoI has released green sukuk reports. The first report was published in February 2019, less than a year since the issuance of the Global Green Sukuk in March 2018. The second report was published in March 2020. Both are entitled “Green Sukuk Allocation and Impact Report” which were developed to compass investors in understanding the details of Eligible Green Sectors that must coherent with the Indonesia’s Green Sukuk Framework. This publication also provided a report on fund allocations by activity and sector and informs the relevant impacts for each allocation in the form of projected environmental benefits. Buana & Musari (2020) stated that Indonesia’s Green Sukuk Report mechanism in line with the concept of impact investing, which makes social and environmental impacts as benchmarks. Overall, the amount of funds raised, the allocations channeled, and the projected environmental benefits from the issuance of Global Green Sukuk in 2018 and 2019 are shown in the following Table 4.

Regarding the SDGs, the impact of Indonesia’s Green Sukuk for both mitigation and adaptation projects not only to support the achievement of SDGs Goal 13 (Climate Action). Overall, the impact also bring benefit to achieve the Goal 7 (Affordable and Clean Energy), Goal 8 (Decent Work and Economic Growth), Goal 9 (Industry, Innovation, and Infrastructure), and Goal 11 (Sustainable Cities and Communities). Table 5 shows the Eligible Green Sectors which are funded by Indonesia’s Global Green Sukuk and projected environmental benefit in 2018 and 2019 towards SDGs.

Table 3. The eligible green projects of 2019

Refinancing Project			Financing Project	
Sector	Projects' Name	Brief Description	Projects' Name	Brief Description
Renewable Energy	Development of New, Renewable Energy and Energy Conservation Infrastructure	Construction of new and renewable energy infrastructure, with a focus on areas outside current electricity coverage. The project aims to improve the electrification ratio in off-grid areas across the country. Power generation is sourced from solar, mini hydro, and micro hydro power plants.	Planning, Development and Supervision of New, Renewable Energy and Energy Conservation Infrastructure	Construction of new and renewable energy infrastructure, with a focus on areas outside current electricity coverage. The project aims to improve the electrification ratio in off-grid areas across the country. Power generation is sourced from solar and biogas power plants.
	Installation of Energy-Saving Solar Energy Lights in the Rural Area	Installation of energy saving solar-powered lamps in areas with limited or no electricity facilities. These lamps would improve accessibility to lighting for off-grid areas while reducing use of diesel generators.		
Waste and Waste to Energy Management	Improvement of Municipal Solid Waste Management System	Improvement of basic waste management infrastructure services through the development of city, regional and special area-scale of final disposal sites.	Improvement of Municipal Solid Waste Management System	Improvement of basic waste management infrastructure services through the development of city, regional and special area-scale of final disposal sites.
Energy Efficiency	Installation of Navigation Facilities	Construction, rehabilitation and replacement of marine navigation aids and the installation of solar cells to power marine navigation aids. The shift towards solar powered marine navigation aids reduces the use of fossil-fuel sources of power.	n.a	n.a
	Improvement of Land Transportation Traffic Management Services	Installation of road traffic equipment such as traffic signs, area traffic control systems (ATCS) and navigation aids for river and lake crossings (SBNP) with energy-saving sensors.		
	Construction, Rehabilitation and Maintenance of Airport Infrastructures	The installation of solar-powered street lights and solar power plants. It improves the energy efficiency of airports and ensure electricity is sourced from renewable sources.		
Sustainable Transportation	Construction and Management of Railways Infrastructure and Supporting Facilities in Sumatera	Construction of the Trans Sumatra Railway from Aceh to Lampung province The Trans Sumatra Railway causes a mode shift from road transport to rail transport and logistics.	Construction and Management of Railways Infrastructure and Supporting Facilities in Sumatera	Construction of the Trans Sumatra Railway from Aceh to Lampung province. The Trans Sumatra Railway causes a mode shift from road transport to rail transport and logistics.
	Construction and Management of Double Track Railways Infrastructure and Supporting Facilities in Java North Line	The construction of the double track railway project in the Trans Java railway's northern section, upgrading the single-track railway.	n.a	n.a
	Development of Jabodetabek Urban Train	Construction of double-double track of the Jabodetabek urban railway network.	Construction and Management of Double Track Railways Infrastructure and Supporting Facilities in Java Line	Construction of the double track railway project in the Trans Java railway's northern and southern sections, upgrading the single-track railway.
Resilience to Climate Change for Highly Vulnerable Areas and Sectors/Disaster Risk Reduction	n.a	n.a	Construction of Flood Control Facilities	Construction of retention ponds/polders, flood canals, dikes, checkdam, and river maintenance and normalization. It aims to reduce the risk of flooding due to increased rainfall intensity and land use changes.

Source: MoF (2020), Modified

Green Sukuk, Islamic Green Financing

Table 4. The allocation and impact of Indonesia's global green sukuk

		2018	2019
Total Amount		USD1.25 billion (~IDR16.75 trillion)	USD754 million (~IDR11.25trillion)
Allocation by Activity	For Adaptation	17%	11%
	For Mitigation	83%	89%
Allocation by Sector	Renewable Energy	102,519,477 (8%)	41,262,073 (5%)
	Energy Efficiency	73,167,369 (6%)	202,719,713 (27%)
	Resilience to Climate Change for Highly Vulnerable Areas and Sectors/Disaster Risk Reduction	209,818,308 (17%)	80,217,156 (11%)
	Sustainable Transport	772,806,236 (62%)	360,480,724 (48%)
	Waste to Energy & Waste Management	92,508,526 (7%)	69,492,775 (9%)
Total Reduction in CO2e Emission		5,776,497.49 tonnes	3,218,014.41 tonnes
Renewable Energy		7,348,180 kWh of additional power generation capacity	7,429 kWh of additional power generation capacity
		36 m3/ day of biogas production capacity produced	
		2,571,569 Kilolitres of areas with biodiesel distribution	
Sustainable Transportation		960,019 passengers of average urban train passengers per day	691.4 km of railway constructed, linking the nation
Waste and Waste to Energy Management		3,453,241 of households benefitting from improved waste management	2,056,200 of households benefitting from improved waste management
Energy Efficiency		1,253.85 kWh Energy Saved due to Energy Efficiency	n.a

Source: MoF (2020), Modified

Overall, Green Sukuk Report represents the GoI's commitment to full transparency and accountability on the management and use of proceeds. The report reflects continued effort to align sectors towards green growth and maintain GoI's credibility as a government committed to creating a low carbon, climate resilient economy. Considering the GoI's Green Sukuk Report, the issuance of Global Sovereign Green Sukuk was awarded as the Asia Pacific Green/Socially Responsible Investments (SRI) Bond Deal of the Year at the Sustainable and Responsible Capital Market Awards 2018. Indonesia received the International Financing Review (IFR) Asia Awards 2018 for SRI Bond, Islamic Issue. Then, Finance Asia awarded also the Green Sukuk as the Best Environmental, Social and Governance (ESG) Deal for the Achievement Awards Finance Asia 2018.

Table 5. The eligible green sectors of 2019 green sukuk allocation and impact

Sector	Refinancing Project			Financing Project		
	Projects' Name	Result	SDGs	Projects' Name	Result	SDGs
Renewable Energy	Development of New, Renewable Energy and Energy Conservation Infrastructure	Annual GHG Emission Avoided: 134,872.41 tonnes CO2e; 15,607 households with electricity, 7,429 kW power generated, Improves electrification ratio.	7, 8, 9, 11, 13	Planning, Development and Supervision of New, Renewable Energy and Energy Conservation Infrastructure	To be confirmed	7, 8, 9, 11, 13
	Installation of Energy-Saving Solar Energy Lights in the Rural Area	Annual GHG Emission Avoided: 1,184,748 tonnes CO2e; 79,556 Units installed, providing households with lighting.	7, 11, 13			
Waste and Waste to Energy Management	Improvement of Municipal Solid Waste Management System	Annual GHG Emission Avoided: In order to achieve 48,000,000 tonnes CO2e target set in RAN-GRK; 2,056,200 households served.	11, 13	Improvement of Municipal Solid Waste Management System	To be confirmed	11, 13
Energy Efficiency	Installation of Navigation Facilities	Annual GHG Emission Avoided: 141,800 tonnes CO2e; 2,459 units constructed, improvement in marine transport safety.	7, 9, 13	n.a		
	Improvement of Land Transportation Traffic Management Services	Annual GHG Emission Avoided: 203,116 tonnes CO2e; Reducing traffic congestion and improve safety in river and lake crossings.	7, 9, 13			
	Construction, Rehabilitation and Maintenance of Airport Infrastructures	Annual GHG Emission Avoided: 10,478 tonnes CO2e; Usage of renewable energy to power lighting in airports.	7, 9, 13			
Sustainable Transportation	Construction and Management of Railways Infrastructure and Supporting Facilities in Sumatera	Annual GHG Emission Avoided: 213,000 tonnes CO2e; Construction of 343.2 km of railways, shifting mode in logistics and passenger transport.	8, 9, 11, 13	Construction and Management of Railways Infrastructure and Supporting Facilities in Sumatera	To be confirmed	8, 9, 11, 13
	Construction and Management of Double Track Railways Infrastructure and Supporting Facilities in Java North Line	Annual GHG Emission Avoided: 552,000 tonnes CO2e; Upgrading of 338.6 km of doubletrack railway, cut travel time and therefore reduce fuel usage.	8, 9, 11, 13			
Sustainable Transportation	Development of Jabodetabek Urban Train	Annual GHG Emission Avoided: 778,000 tonnes CO2e; Shifting mode from private to public transport, with 314,317,883 trips.	8, 9, 11, 13	Construction and Management of Double Track Railways Infrastructure and Supporting Facilities in Java Line	To be confirmed	8, 9, 11, 13
Resilience to Climate Change for Highly Vulnerable Areas and Sectors/ Disaster Risk Reduction		n.a		Construction of Flood Control Facilities	To be confirmed	8, 9, 11, 13

Source: MoF (2020), Modified

Absolutely, the Green Sukuk initiative in Indonesia has paved the way for the flow of sustainable financing through Islamic green financing. In the future, in order to continue finding innovative instruments and to diversify risks, Musari (2020b, 2020c) recommended the cash waqf linked sukuk (CWLS) scheme for being adopted by green sukuk as thematic and/or other SRI instruments. CWLS in Indonesia has become the new blended finance of fiscal instrument. CWLS scheme is expected to drive the development of the Islamic economic and financial sector, also facilitates religious or philanthropy giving, and provides exponential benefits for tackling climate change, especially during a pandemic.

In addition, Buana and Musari (2020), Musari (2020a) also promoted Blue Sukuk and White Sukuk as other alternative thematic and/or other SRI instruments to tackle climate change and greenhouse gas emissions. The Blue Economy equally plays an important role in reducing carbon. Identical to Green and Blue Sukuk, White Sukuk has the potency to be issued by developing airspace area becomes underlying assets and projects to strengthen the air sectors and associated industries. Moreover, the aviation industry and information and communication technology also contributed to carbon emissions.

REFERENCES

Alam, N., Duygun, M., & Ariss, R. T. (2016). Green sukuk: An innovation in Islamic capital markets. In A. B. Dorsman, Ö. Arslan-Ayaydin, & M. B. Karan (Eds.), *Energy and finance* (pp. 167-186). Springer International Publishing.

Buana, G. K., & Musari, K. (2020, December 28). A new sphere of sukuk: Linking pandemic to Paris agreement. *The World Financial Review, Finance and Banking*. Retrieved from <https://worldfinancial-review.com/a-new-sphere-of-sukuk-linking-the-pandemic-to-the-paris-agreement/>

DPS. (2019a). *Republik Indonesia melanjutkan komitmen dalam pembiayaan berkelanjutan melalui penerbitan green sukuk global*. Directorate of Islamic Financing (DPS) Directorate General of Budget Financing and Risk Management (DJPPR) Ministry of Finance (MoF) Republic of Indonesia.

DPS. (2019b). *Sukuk tabungan ST006, investasi hijau menjaga bumi*. Marketing Material of Directorate of Islamic Financing (DPS) Directorate General of Budget Financing and Risk Management (DJPPR) Ministry of Finance (MoF) Republic of Indonesia.

DPS. (2019c). *Press release: Retail green sukuk series ST006 successful to embrace 56% new millennial investors*. Directorate of Islamic Financing (DPS) Directorate General of Budget Financing and Risk Management (DJPPR) Ministry of Finance (MoF) Republic of Indonesia.

DPS. (2020a). *Press release: Indonesian global sukuk issuance is flooded with order amounting to USD 16.66 billion for USD 2.5 billion issuance*. Directorate of Islamic Financing (DPS) Directorate General of Budget Financing and Risk Management (DJPPR) Ministry of Finance (MoF) Republic of Indonesia.

DPS. (2020b). *Press release: In the middle of pandemic, green sukuk retail series ST007 successful to record the history of the biggest sales during the issuance of sukuk tabungan*. Directorate of Islamic Financing (DPS) Directorate General of Budget Financing and Risk Management (DJPPR) Ministry of Finance (MoF) Republic of Indonesia.

- Gumelar, G. (2019, February 2). Sukuk global RI terbit, Timur Tengah dan AS paling berminat. *CNN Indonesia*. Retrieved from <https://www.cnnindonesia.com/ekonomi/20190222095325-532-371732/sukuk-global-ri-terbit-timur-tengah-dan-as-paling-berminat>
- Hendranata, I. G. Y. (2018). *Green sukuk for innovative infrastructure financing*. A material of presentation at Asian Regional Debt Management Forum.
- IMF. (2015). Islamic finance: Opportunities, challenges, and policy options. International Monetary Fund (IMF) Staff Discussion Note SDN/15/05.
- Ismal, R. (2010). *The management of liquidity risk in islamic banks: The case of Indonesia* (Doctoral thesis). Durham Islamic Finance Program (DIFP) School of Government and International Affairs, Durham University.
- Ismal, R., & Musari, K. (2009a, April 1). Menggagas sukuk sebagai instrumen fiskal dan moneter. *Bisnis Indonesia Daily*, p. 4.
- Ismal, R., & Musari, K. (2009b, April). Sukuk, menuju instrumen fiskal dan moneter. *SHARING Magazine*, 3(28).
- Ismal, R., & Musari, K. (2009c, March 23). Sukuk menjawab resesi. *Republika Daily Newspaper*.
- Kahf, M. (1997). *Instruments of meeting budget deficit in islamic economy*. Research Paper No. 42 1417 H. Islamic Research and Training Institute (IRTI) - Islamic Development Bank (IDB), Jeddah.
- Mo, F., & Indonesia, U. N. D. P. (2018). Indonesia's green bond & green sukuk initiative. Jakarta: Ministry of Finance (MoF) Republic of Indonesia.
- MoF. (2019). Green sukuk, allocation and impact report – February 2019. Jakarta: Ministry of Finance (MoF) Republic of Indonesia.
- MoF. (2020). Green sukuk, allocation and impact report – March 2020. Jakarta: Ministry of Finance (MoF) Republic of Indonesia.
- Moghul, U. F., & Safar-Aly, S. H. K. (2014). Green sukuk: The introduction of Islam's environmental ethics to contemporary islamic finance. *Georgetown International Environmental Law Review*, 27(1), 1–60. doi:10.15408/etk.v19i1.13772
- Morea, D., & Poggi, L. A. (2017). An innovative model for the sustainability of investments in the wind energy sector: The use of green sukuk in an italian case study. *International Journal of Energy Economics and Policy*, 7(2), 53–60.
- Muktiyanto, I. (2019). Green sukuk: innovative financing schemes. A material of presentation at Country Showcase Pre 14th Islamic Financial Services Board (IFSB) Summit, Jakarta.
- Musari, K. (2013a). An analysis of the issuance of sovereign sukuk and its impact on the autonomy of state financial and well-being of society in the kingdom of Bahrain and Malaysia and republic of Indonesia (Doctoral thesis). Postgraduate Program, Airlangga University.

Green Sukuk, Islamic Green Financing

Musari, K. (2013b, June). Analysis of the influence of issuance of sovereign sukuk to the autonomy of state financial and well-being of society in the kingdom of Bahrain and the republic of Indonesia. *Australian Journal of Islamic Banking and Finance*, 2(1), 59–84.

Musari, K. (2019). The evolution of waqf and sukuk toward sukuk-waqf in modern islamic economy. *International Journal of 'Umranic Studies*, 2(1), 45-54.

Musari, K. (2020a, January 7). Menakar peluang sukuk putih untuk SDGs. *Bisnis Indonesia Daily Newspaper*, p. 2.

Musari, K. (2020b). *Cash waqf linked sukuk, a new blended finance of fiscal instrument for sustainable socio-economic development: Lesson learned from Indonesia*. A paper was presented at 12th International Conference on Islamic Economics and Finance (ICIEF) “Sustainable Development for Real Economy” with hosted by Istanbul Sabahattin Zaim University (IZU) and jointly organized by Islamic Research and Training Institute (IRTI) - Islamic Development Bank (IDB) and International Association of Islamic Economics (IAIE) with the collaboration of Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC) and Hamad Bin Khalifa University, Istanbul.

Musari, K. (2020c, November 6). CWLS ritel, momentum kebaikan untuk semua. *Portal Jember, Pikiran Rakyat Media Network*. Retrieved from <https://portaljember.pikiran-rakyat.com/opini/pr-16917002/cwls-ritel-momentum-kebaikan-untuk-semua>

Musari, K. (2020d, November 22). Paris agreement: Joe Biden, ekonomi syariah, dan adopsi hutan. *Portal Jember, Pikiran Rakyat Media Network*. Retrieved from <https://portaljember.pikiran-rakyat.com/opini/pr-16996041/paris-agreement-joe-biden-ekonomi-syariah-dan-adopsi-hutan>

Puig, D., Olhoff, A., Bee, S., Dickson, B., & Alverson, K. (Eds.). (2016). The adaptation finance gap report. United Nations Environment Programme (UNEP).

Ramadhan, I. A., & Wirdyanisih. (2020). Green sukuk issuance as an investment instrument for sustainable development. *Advances in Social Science, Education and Humanities Research*, 413, 95–98. doi:10.2991/assehr.k.200306.189

SC & World Bank. (2019). *Islamic green finance development, ecosystem and prospects*. Kuala Lumpur: Securities Commission (SC) Malaysia.

Sriyana, J. (2009). *Peranan sukuk negara terhadap peningkatan fiscal sustainability*. A paper was presented at Simposium Nasional IV Sistem Ekonomi Islam 2009 ‘Strengthening Institutions on Islamic Economic’ at Universitas Islam Indonesia (UII) Yogyakarta, Yogyakarta.

Tamura, K., & Yu, Y. (2015). Cycles for strengthening mitigation and support. In *The Paris climate agreement and beyond: Linking short-term climate actions to long-term goals* (pp. 33–58). IGES.

UN ESCAP. (2014). Sustainable development financing: Perspectives from Asia and the Pacific. A paper prepared by the United Nations (UN) The Economic and Social Commission for Asia and the Pacific (ESCAP) Secretariat for the Regional Outreach of the Intergovernmental Committee of Experts on Sustainable Development Financing for the Asia-Pacific Region, June 10th-11th, Jakarta.

UNFCCC. (2013). *Gaps in existing institutional arrangements within and outside of the Convention to address loss and damage, including those related to slow onset events*. Technical Paper United Nations Framework Convention on Climate Change (UNFCCC) FCCC/TP/2013/12. Retrieved from <https://unfccc.int/resource/docs/2013/tp/12.pdf>

Wahab, M. Z. H., & Naim, A. M. (2020). Sustainable and responsible investment: Concept and the commonalities with islamic financial institutions. *Etikonomi*, 19(1), 141–154. doi:10.15408/etk.v19i1.13772

Willems, S., & Baumert, K. (2003). *Institutional capacity and climate actions*. Organisation for Economic Co-operation and Development (OECD) Environment Directorate International Energy Agency COM/ENV/EPOC/IEA/SLT(2003)5.

World Bank. (2017, September). Green sukuk set to become sustainable investment tools. *Islamic Finance Bulletin*, (27), 4.

Yu, Y. (2016). *Climate finance in and beyond the Paris agreement: Implementing climate finance commitments in Asia and the Pacific*. A Discussion Paper of Macroeconomic Policy and Financing for Development Division at First High-Level Follow-up Dialogue on Financing for Development in Asia and the Pacific, March 30th-31th, Incheon.

ADDITIONAL READING

Dorsman, A. B., Arslan-Ayaydin, Ö., & Karan, M. B. (Eds.). (2016). *Energy and finance*. Springer International Publishing. doi:10.1007/978-3-319-32268-1

Obaidullah, M. (2017). *Managing climate change: The role of islamic finance*. Islamic Research and Training Institute (IRTI) Policy Paper Series PP/2017/01.

Oubdia, L., & Raghیب, A. (2018). Sukuk-waqf: The islamic solution for public finance deficits. *European Journal of Islamic Finance*, 9(April), 1–7. <https://www.ojs.unito.it/index.php/EJIF>

KEY TERMS AND DEFINITIONS

Ijara: A lease contract.

Sukuk: Certificates of equal value which evidence undivided ownership or investment in the assets in accordance with sharia principles and concepts.

Wakala: A contract between an agent and principal. This contract enables the agent to render service and be paid a fee; A contract where a party authorizes another party to act on behalf of the former based on the agreed terms and conditions as long as he or she is alive.

Wakil: Agent in wakala contract.

Waqf: Islamic endowment; a voluntary and irrevocable endowment of sharia with compliant assets for sharia with compliant purposes.

Chapter 2

Grey Rhinos and Deep Risk: How Climate Change Will Impact Financial Planning

Prince Sarpong

 <https://orcid.org/0000-0001-7846-4399>

University of the Free State, South Africa

ABSTRACT

Discussions on the impact of climate change within the financial services sector have mainly focused on institutional investors. Talk of climate change is all but ignored in financial planning. Financial planning, however, has a profound impact on society and can play a major role in climate change mitigation. Climate change poses an overarching challenge to financial planning and how individuals plan for their long-term goals. The financial services sector which provides the financial instruments for financial planning faces deep uncertainty, which threatens the stability of the sector. The environmental impact of climate change poses an additional risk on health outcomes for individuals. This chapter presents a review of disparate literature to position the risk of climate change as deep risk which has significant implications for financial planning. The chapter outlines how financial planners can prepare themselves and their clients for climate risks while contributing to climate change mitigation as well.

INTRODUCTION

Nassim Taleb coined the term Black Swan to describe highly improbable events which have extremely severe consequences (Taleb, 2007). Black Swans cannot be predicted, their impacts are massive, and only appear predictable in hindsight. There is almost a consensus that the effects of climate change will be extremely debilitating. However, the prime mechanisms creating climate change had been identified as far back as in the late 1890s (McKibben, 2012), therefore, climate change in itself cannot be construed to be a Black Swan, although there are uncertainties surrounding the environmental effects and societal reaction to climate change. Climate change presents a special type of Black Swan called Green Swan or “Climate Black Swan” (Bolton, Després, Pereira Da Silva, Samama & Svartzman, 2020). Green Swans

DOI: 10.4018/978-1-7998-7967-1.ch002

display many similarities with the typical Black Swan. Risks related to climate change typically exhibit fat-tailed distributions, characterised by nonlinearity and Deep Uncertainty. The probability of occurrence cannot be gleaned from past data, and there is a probability of extreme outcomes although such probability is very small (Weitzman (2009, 2011).

Green Swans, however, have three distinguishable features from Black Swans (Bolton et al, 2020). First, although there is a high uncertainty on the effects of climate change, “there is a high degree of certainty that some combination of physical and transition risks will materiali[s]e in the future” (NGFS, 2019, p 4). Second, the devastations from climate change are even more severe than the systemic financial crises that have been experienced in history because climate catastrophes may create an existential threat to humanity. Third, the complex nature of Green Swans is of a higher order than for Black Swans. This is because the complex chain reactions and cascade effects could generate unpredictable dynamics in the environment, geopolitics, society and the economy. “If humanity wishes to preserve a planet similar to that on which civilization developed and to which life on Earth is adapted, paleoclimate evidence and ongoing climate change suggest that CO₂ will need to be reduced ... to at most 350 ppm [parts per million]” (Hansen, et al, 2008, p 217). Data published by the World Meteorological Organization confirms that in 2019, the earth reached 410.5±2 ppm. The 350ppm threshold was crossed in 1988. Many of the major crises of the past started as highly obvious threats which were ignored. Ultimately, the problem, was not weak signals but weak responses to signals: a reluctance to act swiftly as the warning signs showed up (Wucker, 2016).

Behind every Black or Green Swan is a “crash” of Gray Rhinos¹. Prior to the 2007/8 Global Financial Crisis, for example, there were several potential dangers and many experts sounded the alarm (Kapoor, 2018); the Black Swan event occurred when all these obvious dangers finally interacted. This creates a problem that was far greater than any one of them, which then was very difficult to predict. The recent coronavirus pandemic has been classified as a Black Swan event given how unpredictable it was and the extent of devastation it has wreaked on lives and livelihoods (Antipova, 2020; Mazzoleni, Turchetti & Ambrosino, 2020; He & Harris, 2020). However, Nassim Taleb argues that the coronavirus pandemic is not a Black Swan and there was no excuse for governments to not be prepared for this event². Despite considerable evidence of the impending threats of pandemics, for the most part, pandemic preparation was ignored, resulting in wide-scale social and economic losses (MacKenzie, 2020). Wucker (2016) coined the term Grey Rhino to describe highly probable high-impact threats which we have the power to do something about. With Gray Rhinos, it is generally a case not of if, but when. Once all these threats materialise at the same time, they create a Black Swan. Wucker (2016) argues that individuals, heads of states, CEOs of businesses and organisations, are usually not very good at dealing decisively with Gray Rhinos and only tend to act speedily when an unexpected crisis arises out of the blue.

If the obvious issues surrounding climate change are not dealt with, individuals and heads of states, CEOs of businesses and organisations will be ignoring Gray Rhinos in Deep Risk. Deep Risk refers to the permanent loss of real capital (Bernstein, 2013). Mitchell (2016) argues that climate change can engender Deep Risk in four ways namely: personal catastrophe, if the income or investment of a person is affected directly by climate change; inflation, if climate change leads to shortages of commodities or puts pressure on national treasuries, leading to a forced monetary expansion; confiscation of wealth, if society’s reaction to climate change include imposing limits on the emission of greenhouse gases thereby stopping or limiting use of certain assets; and economy-wide devastation, if climate change affects all the major sectors leading to a general devastation of the economy.

Grey Rhinos and Deep Risk

Although the risks of climate change are now obvious, climate risk is not adequately incorporated into business decisions (Mitchell, 2016). Secondly, these risks are all but ignored in financial planning. Many investment and retirement planning models for example, currently do not factor in climate risks. However, in a January 2020 annual letter titled: *A Fundamental Reshaping of Finance*, Larry Fink, the CEO of BlackRock (the world's largest asset management company), concludes that "climate risk is investment risk" (Fink, 2020).

BACKGROUND

Financial planning is a collaborative process between a financial planner and a client that integrates relevant areas of the client's financial and personal circumstances to maximise the client's ability to meet her life goals.³ The quality of financial advice has profound influence on society, both directly and indirectly. Financial planning helps in addressing issues relating to individuals and household financial wellbeing as well as consumer interactions in the broader economy (Williams, 1991). The financial planning industry includes large companies such as UBS Wealth Management and Morgan Stanley Wealth that manage trillions of investors' assets, as well as small individual practices that provide investment advice to clients for a fee. The main activities performed by firms in this industry include providing financial advice and investment counselling to help clients meet their life goals. Financial planners help their clients to plan for their present and future financial needs and this involves taking into consideration all factors and potential factors that can significantly affect client financial plans. A distinction is sometimes made between financial planning and wealth management although wealth managers are in essence, financial planners who work with high net worth individuals and are a subset of financial planners. The financial planning profession is multifaceted and incorporates theories and principles of economics, investments, accounting and taxation, with the aim of helping individuals achieve their financial objectives. There are six broad thematic areas or components of financial planning, each focusing on a specific approach to ensure that financial goals are achieved. Below is a brief description of the six thematic areas of financial planning:

Financial Management: The financial management component of financial planning aims at developing strategies and techniques to optimise short and mid-term cash flow and assets and liabilities of individuals. It entails collecting and synthesising information relating to personal financial statements. This information includes asset acquisition, cash flow, debt, education planning and the provision of emergency funds.

Investment Planning: Investment planning involves the application of investment and portfolio theories as well as financial psychology, to develop strategies and techniques to optimise returns on investments taking into consideration the individual's financial needs and constraints. Different types of financial instruments are employed in investment planning to help the individual achieve her financial objectives.

Risk Management: This involves the management of exposure to uncertainty and financial loss through the identification and assessment of risk and determining suitable mitigation or protection strategies with the appropriate insurance policies.

Tax Planning: The tax planning component of financial planning entails employing suitable tax strategies to maximise the after-tax net worth of the client. It involves an assessment of the principles, current law and practice of taxation and their implications on a client's financial situation.

Retirement Planning: Retirement planning helps the client to prepare adequately for retirement and involves implementing appropriate wealth accumulation and preservation strategies during the active working period of the client and withdrawal and preservation strategies during retirement.

Estate Planning: Estate planning involves the employment of various tax, financial and legal strategies to preserve and transfer accumulated wealth in line with the client's goals.

The Financial Planning Standard Board (FPSB) has developed the six-step financial planning process⁴ to guide financial planning professionals when devising financial planning strategies and making recommendations. The six-step financial planning process entails:

1. Establishing and defining the relationship with the client.
2. Collecting the client's information.
3. Analysing and assessing the client's financial status
4. Developing the financial planning recommendations and presenting them to the client.
5. Implementing the financial planning recommendations.
6. Regularly reviewing the financial plan and client's situation.

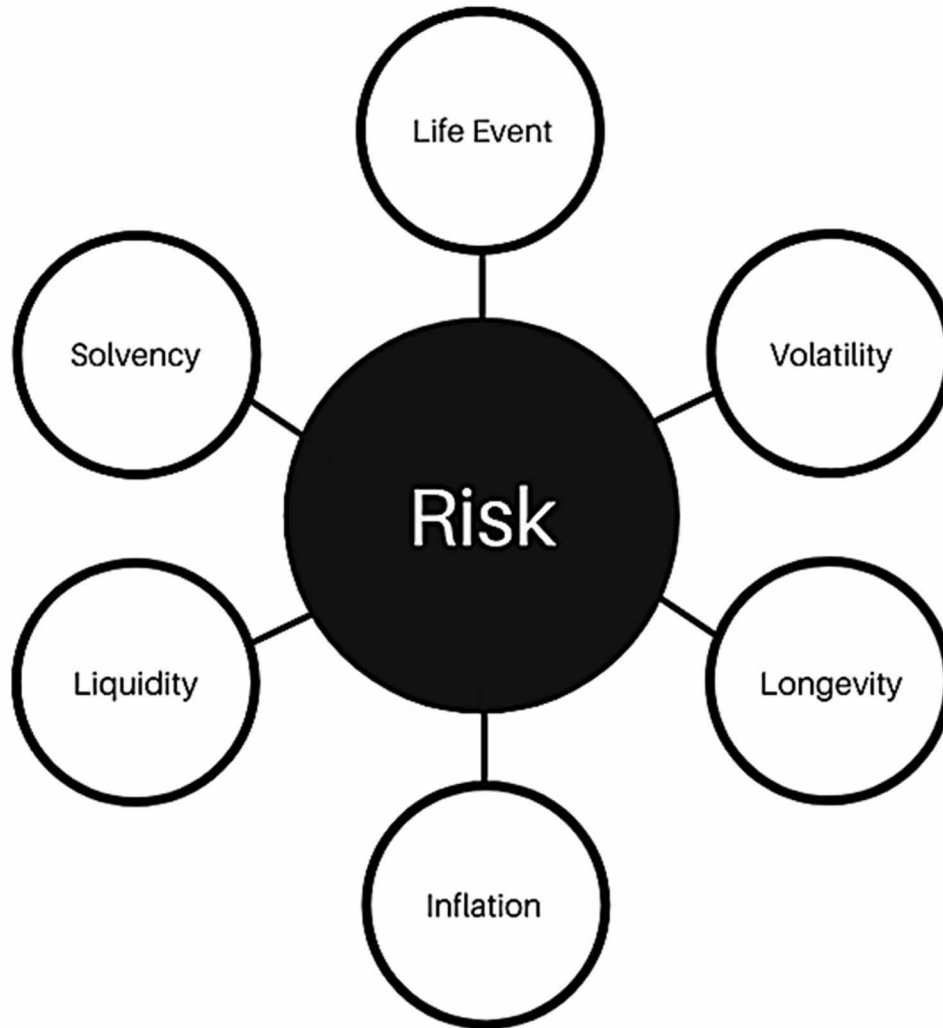
In addition to unique financial circumstances, there are external factors that significantly affect the financial plans of an individual. These factors include inflation, interest rates, the performance of financial markets, the political and socioeconomic environment as well as government policies and regulations. The second step of the financial planning process entails the collection of client-specific, as well as other relevant external information to develop a suitable financial plan. Financial planning recommendations are implemented through financial products made available by the various entities within the financial services industry. The stability of the financial services sector will therefore significantly impact the success of a financial plan. For example, crises such as the 2007/8 Global Financial Crisis and the financial shock associated with the coronavirus pandemic led to significant decline in asset prices which in turn led to massive shocks to the wealth holdings of individuals (Carlsson-Szlezak, Reeves & Swartz, 2020; Hanspal, Weber, & Wohlfart, 2020). This is particularly devastating to people who are likely to experience significant declines in their accumulated retirement savings with little time left to recoup such losses. In making recommendations, the financial planner takes into consideration all the potential risks that can have a negative impact on a client's financial plan and how these risks can be eliminated or mitigated.

Assessing Risk in Financial Planning

Risk can have different meanings depending on the context. Generally, risk can be defined as the possibility of something bad happening⁵ and involves uncertainty around the outcomes or consequences of an activity regarding anything of value such as health, well-being, wealth, property or the environment, and often focusing on negative or unfavourable outcomes (Aven et al., 2018). In financial terms, risk is also referred to as volatility and is defined as the chance that an investment's actual gains will differ from an expected outcome or return. In this regard, investments that delivers returns that are higher than or lower than the expected return are all considered risky. From a layman's perspective, this may not make sense as risk only means the possibility of losing, which is a deviation below the mean. This is called downside risk in finance. However, from the perspective of an investor, this definition of risk makes sense as all investors aim to buy low and sell high. Fluctuations above and below the mean therefore are essential for market-timing decisions as there is the risk of selling a stock at the wrong time (Sarpong, 2020).

Figure 1. The risk factors in financial planning

Source: Author



In financial planning, several risk factors can have negative and significant impact the success of a financial plan. These risk factors are shown in Figure 1. Life events such as severe or critical illness or disability, can prevent people from carrying on with their normal work to earn incomes. This can have a negative impact on their current and future standard of living. An untimely death can also lead to a negative financial impact on one’s dependants. Investment volatility can also have debilitating impact on one’s financial plans if one is forced to sell investments when markets are heavily depressed. Selling financial assets in highly depressed markets can lead to a permanent loss of capital as one may be selling assets at prices lower that what was paid to acquire such assets.

Longevity can also pose a serious risk when a person outlives her retirement savings. Inflation reduces the purchasing power and the real value of an investment and liquidity risk occurs when there are

not enough liquid assets in one's portfolio, which might lead to a forced disposal of illiquid assets at an unfavourable time for an unfavourable price. Solvency risk occurs when one's total liabilities exceed total assets, and this ultimately affects the long-term ability for one to pay off debts.

Through proper financial planning, life event risks can be eliminated or mitigated through appropriate insurance policies such as critical illness and disability insurance or life insurance policies. Volatility can be mitigated by holding a globally diversified portfolio and having enough liquidity. By saving more for retirement, and through the appropriate investments, longevity risk can be mitigated. Investing in assets that produce above-inflation returns can mitigate against inflation risk while liquidity risk can be avoided by holding an adequate amount of liquid investment in one's portfolio and through proper budgeting, solvency risk can also be avoided.

Risk can also be categorised based on the ability to avoid it or the possibility of recovery once the risk occurs. Bernstein (2013) describes two categories of risks namely Shallow Risk and Deep Risk. Shallow risk is the loss of real capital that can be recovered relatively quickly, for example, within several years. Deep Risk on the other hand, refers to the permanent loss of capital. Shallow Risk can be avoided or mitigated through liquidity i.e., holding enough liquid assets in one's portfolio. Shallow Risk can therefore be construed to be volatility. Deep Risk possess a greater challenge than Shallow risk in achieving one's financial goals. The risks associated with climate change possess Deep Risk to one's financial planning in four ways namely, personal catastrophe, inflation, confiscation of wealth and risks due to general or economy-wide devastation.

Personal Catastrophe: This occurs when one's living conditions, investments or other income is affected directly by climate change. According to the United States Global Change Research Program, there is an increase in risks due to extreme heat, flooding, reduced outdoor air quality, water- and food-related infections, mental health risks and vector-borne infections, such as Lyme disease and the Zika virus (Crimmins, Bell, Fann, & Hawkins, 2016). Many of these risks are noticeable now and poised to increase as a result of climate change (Mitchell, 2016).

Inflation: Climate change and natural disasters that are associated with climate change will lead to damages to land and capital and also intensify the rate of capital depreciation which will have a negative and long-term effect on output and income (Fankhauser & Tol 2005; Stern 2013). Per capita GDP is also projected to decline by 7 per cent by 2100 for every 0.04 °C increase in temperatures (Kahn et al. 2019). Furthermore, climate change can cause inflation if it leads to shortages of commodities or puts pressure on national treasuries thus forcing monetary expansion, or the confiscation of wealth.

Confiscation of Wealth: This may be largely indirect, for example, the policy of limiting the emission of greenhouse gases may limit or prevent the use of assets which produce greenhouse gasses. Globally, massive values of assets in some industries will be rendered redundant as they will not have any value or generate any income, especially if signatory countries stick to the Paris Agreement. By 2030, an estimated \$1 trillion to \$4 trillion in assets in the oil and gas sector, for example, are projected to become stranded⁶ (Mercurio et al., 2018).

Economy-Wide Devastation: A general or economy-wide devastation will automatically have a negative impact on the financial position of the majority of individuals within the economy (Mitchell, 2016). The risk profiles of many households will likely deteriorate significantly due to the impact of climate change (Carney, 2015).

As a Green Swan event, climate change and its associate risks pose a more severe risk greater than that experienced during the Global Financial Crisis. This is because climate change leads to a state of affairs commonly referred to as Deep Uncertainty "Deep Uncertainty exists when parties to a decision

Grey Rhinos and Deep Risk

do not know, or cannot agree on, the system model that relates action to consequences, the probability distributions to place over the inputs to these models, which consequences to consider and their relative importance.” (DMDU Society, 2020). Under Deep Uncertainty, historical data is no longer useful for planning. Deep Uncertainty will heavily impact the financial planning and how individuals manage their financial risks and prepare for future life events.

The process of financial planning takes into consideration the relevant information relating to the individual as well as external factors which can affect the success of a financial plan. Retirement planning for example, may entail Monte Carlo simulations to model future uncertainty with underlying assumptions on long-term rates of returns. Other variables that are also taken into consideration include life expectancy (the goal is to ensure one does not outlive his/her retirement savings), projected rate of inflation and future expenses. Risk management in financial planning entails the use of different types of insurance policies to mitigate potential risks. Life expectancy is a fundamental variable in determining the risk factor of an individual and the probability that they will make a claim. Insurance companies take age, medical history, lifestyle choices and many other factors into consideration to determine the rates of premium for life insurance policies. The impact of climate change on insurance companies is projected to be severe as heavy climate related insurance losses may cause distress or failure of insurance companies⁷. In response to increasing climate risks, insurance companies may also reduce coverage, which consequently, can reduce the value of collateral and create constraints on credit for firms as well as households (Batten, Sowerbutts & Tanaka, 2016). Credit constraints will arise mainly because, once there is no coverage, some of the losses related to the climate will have to be borne directly by individuals, which in turn will negatively impact their risk profiles.

Bolton et al (2020) argues that if system-wide action is not taken, climate-related risks will mostly remain unhedgeable or uninsurable. Homeownership, coupled with amortizing mortgages, is a key driver of household wealth building (Bernstein & Koudijs, 2020); however, climate risk and the availability of insurance for property, can affect the prices and the rates of return of real estate, which in turn will negatively impact individual net worth. In Florida, for example, private insurers routinely exclude storm surge and wind coverage, public insurers and the general public are left to cover the risk (Linden, 2014). Such decrease in coverage will consequently have a negative impact on the net worth and risk profiles of individuals.

RISKS OF CLIMATE CHANGE

There are two categories of risks associated with climate change namely: physical risk and transition risk. Physical risk may affect companies directly and indirectly. The direct risk will stem from damage or loss of assets, and the indirect risk will be experienced through the effects of climate change on value chains, and their impact on financial performance, including impact on intangible assets such as reputation and brand (Institutional Investors Group on Climate Change, 2020). Governments of almost 200 countries were signatories to the 2015 Paris Agreement with the aim of limiting global warming to ‘well below 2°C’ above pre-industrial levels (TCFD, 2017). This transition to a low-carbon economy however comes with considerable transition risk for several companies in different industries globally. This is because, governments may implement far-reaching regulations and policies to achieve these targets. The 2°C objective will render more than 80 per cent of all proven fossil fuel reserves and investments in these resources stranded (Bos & Gupta, 2019).

The impact of transition risk on companies ranges from direct and indirect costs, to evolving regulations, business models, technologies and stranded assets. In a global survey of 439 institutional investors, 50 per cent of the respondents maintain that such regulatory risks have started materialising, and less than 10 per cent maintain they will only materialise in ten years at the earliest (Krueger, Sautner, & Starks, 2020). The TCFD (2017) distinguishes between four types of transition risk namely: (1) legal risk, which will emanate from climate-related litigation claims, (2) market risk, which will emanate from fundamental changes in global supply of and/or demand for certain goods and services, (3) technology risk, which will emanate from innovations in technology to support the transition but disrupt existing technologies or industries, and (4) reputation risk, which will emanate from the changing perception of customers or communities towards certain companies.

The impacts of climate change will be more severe relative to other structural drivers, and frequently irreversible. Using random year-to-year variation in temperature, Deschênes and Greenstone (2011) investigated the relationship between annual mortality rates and daily temperatures, and annual residential energy consumption and daily temperatures, and found nonlinearity in both relationships, with significant increases at the extremes of the temperature distribution. They conclude that if we apply these results to ‘business as usual’ climate predictions, then by the end of the century, climate change will cause a 3 per cent increase in the age-adjusted mortality rate and 11 per cent increase in yearly residential energy consumption. Although Deschênes and Greenstone (2011) argue that these estimates likely overstate the long-run costs since climate change will unfold gradually, thus allowing individuals to engage in a wider set of adaptations, the element of Deep Uncertainty associated with climate change may render historical information less useful making it valueless in helping to understand potential future trajectories. Insurers, for example, are re-evaluating their risk models, particularly, the use of historical patterns, as a result of the evolving severity and frequency of climate-related events. Whereas global emissions paths are fairly forecastable, the main uncertainty lies with the ability to forecast the path or ability of economic actors to adjust to new circumstances.

Furthermore, risks related to climate change are difficult to assess. This is because the Deep Uncertainty associated with climate risk make it different from other systematic risks like market, liquidity and credit risk, that investors are used to analysing. Also, physical and transition risk can interact in different ways. For example, a swift transition can lead to increased transition risk but can also reduce physical risk. On the other hand, unanticipated realisations of physical risk, or if physical risk materialises quicker than expected, can in turn, increase transition risk.

All economic sector will be impacted by climate change, but the severity will differ among the sectors. Agriculture, water, infrastructure and transport are particularly vulnerable. Agriculture, for example, is vulnerable due to its dependence on precipitation, the availability of water for irrigation, and the need for the environment to remain within the historical temperature ranges. The impacts are projected to be negative and severe. Lesk, Rowhani, and Ramankutty (2016) in cross-country study, for example, found that extreme heat and droughts decrease the production of cereal production by 9 to 10 per cent.

Since climate change will affect many sectors and companies, the extent to which decision making incorporates climate risk will affect their risk and return. Insurance companies probably are a unique sector in this regard as they may experience shocks on both sides of their balance sheet. Changes in longevity as a result of climate change will affect their liabilities, while changes in security returns will affect their assets (Arndt, Loewald, & Makrelov, 2020). Ozili (2020) however argues that financial institutions through their inaction appear to be unmoved by risks related to climate change although climate change will have a significant impact on financial institutions and the financial system. The

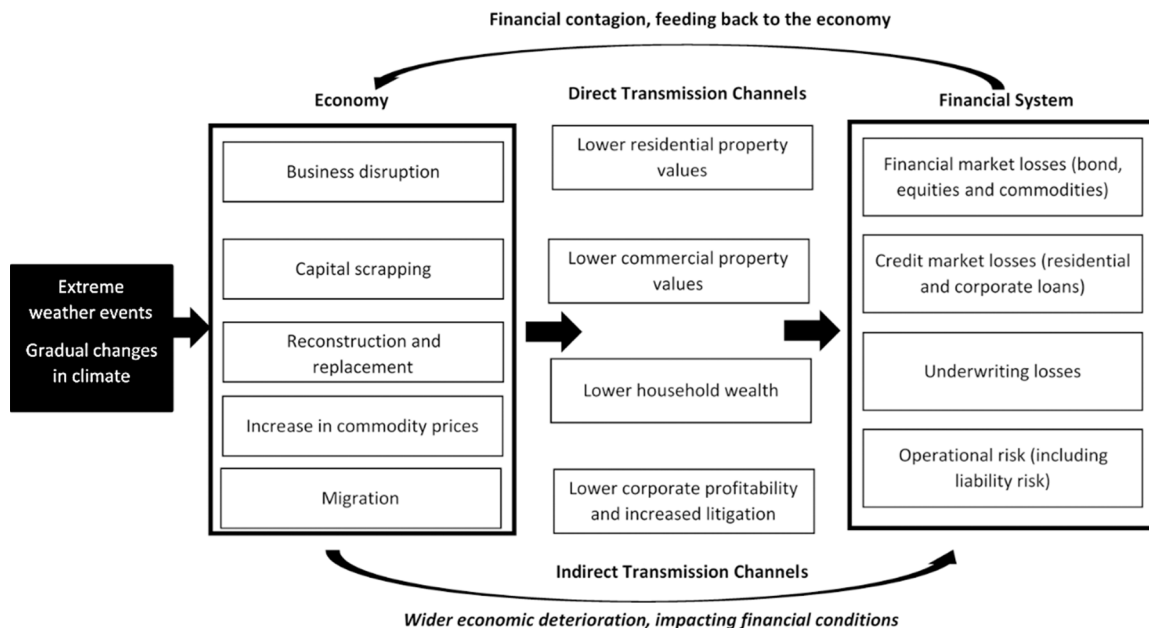
Grey Rhinos and Deep Risk

energy sector is projected to be one of the industries that will suffer significant shocks due to climate change. Gundlach (2020) reports that the number of plaintiffs that are suing energy firms for ignoring climate-related risks is growing. That notwithstanding, the energy sector is not ready, and not preparing, for climate change and these lawsuits are pushing the energy sector to regard such risks as a cost of doing business (Gundlach, 2020).

CLIMATE RISK AND FINANCIAL PLANNING

In financial planning, the main question to be considered is: is the risk of climate change a future or current problem? Although some of the major risks relating to climate change will only unravel over the long term, climate change risks can have an immediate and negative effect on personal and financial wellbeing and also, over the long term throughout retirement. The world has witnessed dramatic climate events in the past few years and the negative and immediate impact of natural disasters are occurring more frequently and with greater intensity. Many of the factors leading to climate change also increase the risk of pandemics. This is because, as the planet heats up, different animals are all heading to the poles to avoid the heat and are coming into closer contact with other animals they normally would not, thereby creating opportunities for pathogens to get into new hosts (Harvard School of Public Health, 2020).

Figure 2. From physical to financial risks
Source: NGFS (2019)



An increase in the frequency and severity of natural disasters, will lead to an increase in financial instability and fiscal risk as government expenditures in response to disasters will put national treasur-

ies under great stress, especially in period where revenue may also be under severe constraints. Batten, Sowerbutts, and Tanaka (2016) and Batten (2018) point out a number of channels for financial instability. Figure 2 provides a graphical representation of these channels. Weather related events lead to negative economic shocks which in turn affect asset prices and balance sheets, and consequently generating credit and financial market losses as well as increased operational and liability risks. The impact of flooding and other natural disasters may also force people to migrate to safer regions.

Risk related to climate change is likely to increase the risk profile of individuals due to the climate-related health and mortality risks coupled with decreasing coverage of insurers on climate-related risks. The situation is further worse by the negative impact on household net worth as climate change may lead to decline in residential property values as well as investment portfolios. Individuals with portfolio exposure to industries affected by stranded assets will experience negative impact on their investment returns. Financial planners can help mitigate some of these negative impacts on their clients' net worth through adequate exposure of client portfolios to industries that are poised to benefit as the world transitions into more sustainable practices. Global electricity demand for example, is projected to increase by 30 per cent by 2030, spurring about \$23 trillion investment opportunities in renewable energy over the next decade, according to the IFC (IFC, 2016). This implies that not all sectors will suffer. While some sectors may experience significant losses due to stranded assets, other sectors are poised to gain.

CLIMATE CHANGE MITIGATION THROUGH FINANCIAL PLANNING

Financial planning has a profound influence on society both directly, and indirectly through the law of unintended consequences. Wilcox and Fabozzi (2013) for example, argue that, had lenders and borrowers received better financial advice, this could have gone a long way in helping to avert much of the 2007/2008 Global Financial Crisis. Bad credit choices on mortgage lending ultimately culminated in the interference with the credit flow for business expansion, especially for small businesses, which are very crucial for economic growth and employment (Wilcox & Fabozzi, 2013). Given the amount of funds under its control, the wealth management industry, together with individual 'climate conscious' personal financial planning can help mitigate some of the risks relating to climate change.

The Wealth Management Industry

In 2019, total assets under management (AuM) in the global wealth management industry⁸ was \$89 trillion. Retail investors represent 42 per cent of the global assets at \$37 trillion, while institutional clients represent 58 per cent of the market (\$52 trillion). Given the huge amounts of assets under management, the wealth management industry has the capacity to play an active role in climate change mitigation. In 2006, a group of major institutional investors in collaboration with the UN Global Compact and the United Nations Environment Programme Finance Initiative developed the *Principles for Responsible Investment* with the belief that "an economically efficient, sustainable global financial system is a necessity for long-term value creation. Such a system will reward long-term, responsible investment and benefit the environment and society as a whole." (UNGC, UNEP-FI, 2016, p 4). In total, signatories to these principles were responsible for managing almost \$90 trillion globally as at January 2020 (Saa, 2020).

Personal Financial Planning

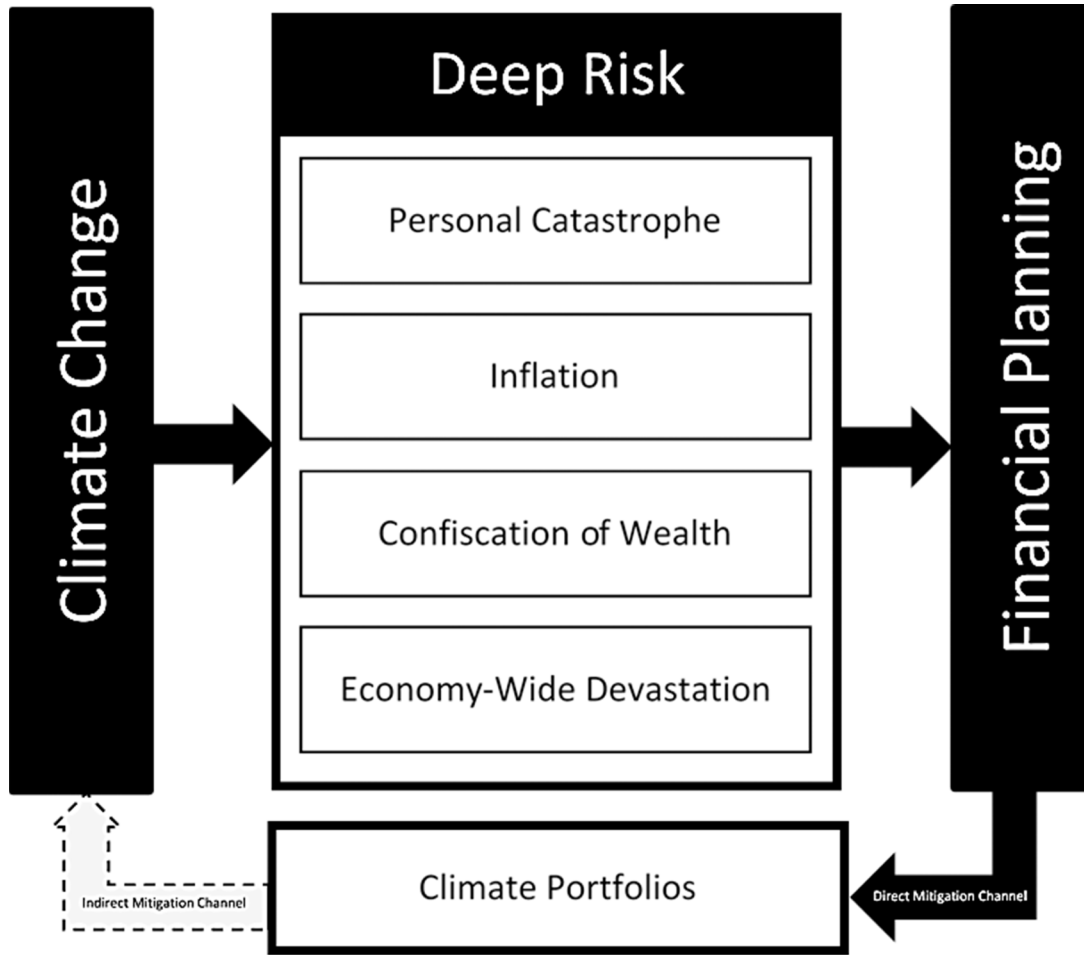
With evidence that climate risk is not adequately incorporated into business decisions, financial planners and their clients need to be aware of how climate related risks can affect financial plans. Awareness of climate risk requires education about climate change and the consideration of how investments may benefit or suffer as a result of climate change and society's response to climate change. Financial planners and their clients can actively engage in climate mitigation through financial planning by developing the habit of scanning for Deep Risk, favouring investments that takes climate risk into consideration and avoiding climate risk where possible. Mitchell, (2016) advocates that financial planners and clients should aim at holding *climate risk portfolios*. A climate risk portfolio is diverse and avoids highly illiquid assets that are subject to climate risk. A house which is two feet above sea level, for example, may be safe for 50 years. However, if the owners wait until water is reaching the doorstep before deciding to sell, they will lose all value. Climate risk portfolios also favour investments that are on the right side of history. These are investments in companies that are aware of their greenhouse gasses (GHG) impact, take steps to mitigate their impacts, and contribute to the task of finding ways to adapt to climate change. Long-term change due to the climate risk is inevitable and at some point, the market will begin to react.

Mitchell, (2016) argues that the only investments that are likely to help investors avoid much of the Deep Risk are inflation-protected debt and liquid publicly traded equity. Ultimately, companies, and investors that deny climate risk are likely to experience huge losses. Companies that take climate risk seriously have lower chances of heavy declines in valuation and higher chances of benefitting from the opportunities inherent in any large-scale changes in societal interaction with the physical environment. There is now evidence that investors are taking sustainability issues seriously. Pástor and Vorsatz (2020) report that investors favour funds with high sustainability ratings. Investors also remained focused on sustainability during the recent coronavirus crisis. This suggests that investors now view sustainability as a necessity.

In the world of investment and finance, diversification across different geographical regions, economic sectors and asset classes is viewed as the most effective approach to reduce the idiosyncratic (non-systematic) risk of an investment portfolio. Although there is a considerable heterogeneity in the extent to which various assets are exposed to the climate-related risk and many sectors and companies will be negatively affected, there are sectors and companies that are likely to experience positive effects (Balvers, Du, & Zhao, 2017). The transition to a low-carbon economy will imply a fundamental overhaul of the economic system and significant disruptions to existing business models and sectors, but it will also be the catalyst for new sectors and business models. There will therefore be winners and losers due to this transition. Holding a broadly diversified portfolio and investing in sectors and companies that are likely to be winners could thus be effective in reducing the overall exposure of a portfolio to climate risk.

Figure 3. How climate change affects financial planning

Source: Author



Andersson, Bolton, and Samama (2016) examined a decarbonised MSCI Europe index with a 50 per cent lower carbon footprint than the regular MSCI Europe index over 2010-2016 and concluded that investing in the decarbonised index implicitly comes with a ‘free option on carbon’. They argue that in a business as usual scenario, both indices should have similar performance, however, the decarbonised index should start outperforming once transition risk kicks in. Pástor and Vorsatz (2020) studied the performance of fund during the coronavirus crisis and found that funds with high sustainability ratings also have good performance (Pástor & Vorsatz, 2020). Some insurance companies are now also allowing clients take some steps in climate change mitigation as they manage their own risks. These companies are now permitting policyholders to select the types of investments the premium payments should be directed to. For example, Société Générale and Entelligent have formed a partnership to establish a fixed-income annuity product that allows clients to direct their capital to firms that are taking steps to fight climate change (Waddell, Beal, & Cockerill, 2020). Proactively divesting in certain sectors, while increasing investments in other sectors, such as renewable energy, can go a long way in addressing climate change. Figure 3 shows a conceptual framework of how climate change will affect financial planning and how

Grey Rhinos and Deep Risk

financial planning can also contribute towards the mitigation of climate change. Climate change possess Deep Risk to financial planning; however, individuals can insulate their financial plans against the risks of climate change through climate portfolios. These are direct channels through which financial planning can be used to mitigate against the risk of climate change to an individual's financial plans. Furthermore, these climate portfolios can also serve as an indirect channel through which the risks of climate change can be mitigated. This is because climate portfolios allow individuals to hold investments in entities that are acting in response to climate change and thus providing financing and funding to these entities.

It is important for financial planners to actively engage clients on the impact of climate change on their financial planning and look for ways to position the investments of their clients against climate related risks. In doing so, they will also be channelling their capital towards financing solutions for environmental challenges. It is important for financial planners to have some understanding of the climate discussions and how they relate to companies and investment portfolios. This will enable them to help their clients navigate the evolving investment landscape.

FUTURE RESEACH AND DIRECTION

There is scant literature on the impact of climate change on financial planning and how financial planning can contribute to the mitigation of climate change. This chapter was aimed at bringing together desperate literature on the risks that climate change poses to the financial services industry, and to position climate change as Deep Risk which has significant implications for financial planning. The chapter also sheds light on the potential of financial planning to significantly contribute to climate change mitigation. There are a number of financial planning focused research which can contribute to the discussion on climate change and its impact on the financial services industry. Future research could focus on the extent to which financial planners incorporate climate risks in the financial planning process and in the risk profiling of clients.

CONCLUSION

As social and environmental consciousness is becoming more prevalent, there is a need to incorporate concepts of impact investing, social responsibility, Environmental, Social, and Governance (ESG) issues, and climate change topics to the individual, family, and household level. This is because climate related risks pose Deep Risk not just to companies but also to individuals and households. Although there is a high uncertainty surrounding the impact of climate change, there is also a high degree of certainty that the risks of climate change will materialise. It is therefore important for financial planners to start incorporating climate risk into their financial planning models as climate risk is investment risk. Failure to incorporate climate risk into financial plans of clients creates the problem of Gay Rhinos which will be exacerbated by the Deep Risk nature of climate change which if left unchecked, will ultimately lead to more debilitating Green Swans in future. Regularly doing a Gray Rhino reality check will allow financial planners and their clients to create climate risk portfolios which are likely to be relatively more resilient with lower chances of massive declines in valuation and greater chances of benefiting from the opportunities inherent in any large-scale changes that will occur as society devices new ways of interacting with the physical environment. Being aware of climate risks and taking active steps to deal with

them in one's financial planning will also contribute to mitigating climate risk both for the individual and the environment as a whole. Climate change has already affected businesses and financial markets. It is therefore important for financial planners to start getting informed in order to better prepare their businesses and clients to stay ahead of the investment curve.

REFERENCES

- Andersson, M., Bolton, P., & Samama, F. (2016). Hedging climate risk. *Financial Analysts Journal*, 72(3), 13–32. doi:10.2469/faj.v72.n3.4
- Antipova, T. (2020). Coronavirus Pandemic as Black Swan Event. In *International Conference on Integrated Science* (pp. 356-366). Springer.
- Arndt, C., Loewald, C., & Makrelov, K. (2020). *Climate change and its implications for central banks in emerging and developing economies*. Economic Research and Statistics Department, South African Reserve Bank.
- Aven, T., Ben-Haim, Y., Boje Andersen, H., Cox, T., Droguett, E. L., Greenberg, M., . . . Thompson, K. M. (2018). *Society for risk analysis glossary*. Society for Risk Analysis.
- Balvers, R., Du, D., & Zhao, X. (2017). Temperature shocks and the cost of equity capital: Implications for climate change perceptions. *Journal of Banking & Finance*, 77, 18–34. doi:10.1016/j.jbankfin.2016.12.013
- Batten, S. (2018). *Climate change and the macro-economy: a critical review*. Bank of England working papers (706).
- Batten, S., Sowerbutts, R., & Tanaka, M. (2016). Let's talk about the weather: The impact of climate change on central banks (No. 603). Bank of England.
- Bernstein A. Koudijs P. (2020). Mortgage Amortization and Wealth Accumulation. SSRN 3569252.
- Bernstein, W. J. (2013). *Deep Risk: How History Informs Portfolio Design*. Efficient Frontier Publications.
- Bolton, P., Després, M., da Silva, L. A. P., Samama, F., & Svartzman, R. (2020). *The green swan: Central banking and financial stability in the age of climate change*. Bank for International Settlements.
- Bos, K., & Gupta, J. (2019). Stranded assets and stranded resources: Implications for climate change mitigation and global sustainable development. *Energy Research & Social Science*, 56, 101215. doi:10.1016/j.erss.2019.05.025
- Carlsson-Szlezak, P., Reeves, M., & Swartz, P. (2020). What coronavirus could mean for the global economy. *Harvard Business Review*, 3, 1–10.
- Crimmins, A., Bell, J., Fann, N., & Hawkins, M. (2016). *The impacts of climate change on human health in the United States: A Scientific Assessment*. Retrieved from <https://health2016.globalchange.gov/>
- Decision Making Under Deep Uncertainty (DMDU) Society. (2020). *About Us*. <https://www.deepuncertainty.org/about-us/>

Grey Rhinos and Deep Risk

- Deschênes, O., & Greenstone, M. (2011). Climate change, mortality, and adaptation: Evidence from annual fluctuations in weather in the US. *American Economic Journal. Applied Economics*, 3(4), 152–185. doi:10.1257/app.3.4.152
- Fink, L. (2020, January 14). *A Fundamental Reshaping of Finance*. BlackRock. Retrieved from <https://www.blackrock.com/corporate/investor-relations/larry-fink-ceo-letter>
- Gundlach, J. (2020). Climate risks are becoming legal liabilities for the energy sector. *Nature Energy*, 5(2), 94–97. doi:10.103841560-019-0540-x
- Hansen, J., Sato, M., Kharecha, P., Beerling, D., Berner, R., Masson-Delmotte, V., . . . Zachos, J. C. (2008). *Target atmospheric CO₂: Where should humanity aim?* arXiv preprint arXiv:0804.1126.
- Hanspal, T., Weber, A., & Wohlfart, J. (2020). Exposure to the COVID-19 stock market crash and its effect on household expectations. *The Review of Economics and Statistics*, 1–45. doi:10.1162/rest_a_01011
- Harvard School of Public Health. (2020). *Coronavirus and climate change*. Retrieved from <https://www.hsph.harvard.edu/c-change/subtopics/coronavirus-and-climate-change/>
- He, H., & Harris, L. (2020). The impact of Covid-19 pandemic on corporate social responsibility and marketing philosophy. *Journal of Business Research*, 116, 176–182. doi:10.1016/j.jbusres.2020.05.030 PMID:32457556
- IFC. (2016). *Climate Investment Opportunities in Emerging Markets*. Retrieved from https://www.ifc.org/wps/wcm/connect/59260145-ec2e-40de-97e6-3aa78b82b3c9/3503-IFC-Climate_Investment_Opportunity-Report-Dec-FINAL.pdf?MOD=AJPERES&CVID=IBLd6Xq
- Institutional Investors Group on Climate Change. (2020). *Understanding physical climate risks and opportunities – a guide for investors*. Retrieved from <https://www.iigcc.org/download/understanding-physical-climate-risks-and-opportunities-a-guide-for-investors/?wpdmdl=3388&refresh=600fad28b8cd61611640104>
- Kapoor, M. (2018, September 28). These people predicted the 2008 recession and were laughed at! *Business Today*. Retrieved from <https://www.businesstoday.in/top-story/these-people-predicted-the-2008-recession-and-were-laughed-at/story/283071.html>
- Krueger, P., Sautner, Z., & Starks, L. T. (2020). The importance of climate risks for institutional investors. *Review of Financial Studies*, 33(3), 1067–1111. doi:10.1093/rfs/hhz137
- Lesk, C., Rowhani, P., & Ramankutty, N. (2016). Influence of extreme weather disasters on global crop production. *Nature*, 529(7584), 84–87. doi:10.1038/nature16467 PMID:26738594
- Linden, E. (2014, June 16). How the Insurance Industry Sees Climate Change. *The Los Angeles Times*. Retrieved from <https://www.latimes.com/opinion/op-ed/la-oe-linden-insurance-climate-change-20140617-story.html>
- MacKenzie, D. (2020). Pandemic warnings. *New Scientist*, 247(3300), 46–49. doi:10.1016/S0262-4079(20)31628-6

- Mazzoleni, S., Turchetti, G., & Ambrosino, N. (2020). The COVID-19 outbreak: From “black swan” to global challenges and opportunities. *Pulmonology*, 26(3), 117–118. doi:10.1016/j.pulmoe.2020.03.002 PMID:32291202
- McKibben, B. (2012). *The global warming reader: A century of writing about climate change*. Penguin.
- Mercure, J.-F., Pollitt, H., Viñuales, J. E., Edwards, N. R., Holden, P. B., Chewpreecha, U., Salas, P., Sognaes, I., Lam, A., & Knobloch, F. (2018). Macroeconomic impact of stranded fossil fuel assets. *Nature Climate Change*, 8(7), 588–593. doi:10.1038/41558-018-0182-1
- NGFS. (2019). *NGFS First Comprehensive Report. A Call for Action - Climate Change as a Source of Financial Risk*. Retrieved from <https://www.ngfs.net/en/first-comprehensive-report-call-action>
- Ozili, P. K. (2020). Effect of climate change on financial institutions and the financial system. In *Uncertainty and Challenges in Contemporary Economic Behaviour*. Emerald Publishing Limited. doi:10.1108/978-1-80043-095-220201011
- Pástor, L., & Vorsatz, M. B. (2020). Mutual fund performance and flows during the COVID-19 crisis. *Review of Asset Pricing Studies*, 10(4), 791–833. doi:10.1093/rapstu/raaa015
- Saa, L. (2020, January 27). *PRI welcomes 500th asset owner signatory*. Retrieved from <https://www.unpri.org/pri-blogs/pri-welcomes-500th-asset-owner-signatory/5367.article>
- Sarpong, P. (2020). *Portfolio Management for Financial Advisors*. Centre for Financial Planning Studies.
- Taleb, N. N. (2007). *The black swan: The impact of the highly improbable* (Vol. 2). Random house.
- TCFD. (2017). *Final report: recommendations of the task force on climate-related financial disclosures*. Financial Stability Board Task Force on Climate-related Financial Disclosures. Available at: www.fsb-tcfd.org/wp-content/uploads/2017/06/FINAL-TCFD-Report-062817.pdf
- UNGC & UNEP-FI. (2016). *Principles for responsible investment*. Retrieved from https://www.sed-cocapital.com/sites/default/files/downloads/pri_brochure_2016_0.pdf
- Waddell, R., Beal, D., & Cockerill, D. (2020). *Insurers Take Up the Climate Fight*. Retrieved from <https://www.bcg.com/publications/2020/insurers-take-up-the-climate-fight>
- Weitzman, M. L. (2009). On modeling and interpreting the economics of catastrophic climate change. *The Review of Economics and Statistics*, 91(1), 1–19. doi:10.1162/rest.91.1.1
- Weitzman, M. L. (2011). Fat-tailed uncertainty in the economics of catastrophic climate change. *Review of Environmental Economics and Policy*, 5(2), 275–292. doi:10.1093/reep/rer006
- Wilcox, J. W., & Fabozzi, F. J. (2013). *Financial Advice and Investment Decisions: A Manifesto for Change* (Vol. 195). John Wiley & Sons. doi:10.1002/9781118656761
- Williams, F. L. (1991). *Theories and techniques in financial counseling and planning: A premier text and handbook for assisting middle and low income clients*. Purdue Research Foundation.
- Wucker, M. (2016). *The gray rhino: How to recognize and act on the obvious dangers we ignore*. Macmillan.

ENDNOTES

- ¹ “Crash” is the zoological term for a group of rhinos.
- ² <https://www.bloomberg.com/news/videos/2020-03-30/nassim-taleb-says-white-swan-coronavirus-pandemic-was-preventable-video>
- ³ Certified Financial Planner Board of Standards, Inc., CFP Board’s Standards of Professional Conduct. Available at <https://www.cfp.net/-/media/files/cfp-board/standards-and-ethics/cfp-code-and-standards.pdf>
- ⁴ <https://www.fpsb.org/about-financial-planning/financial-planning-process/>
- ⁵ Cambridge dictionary.
- ⁶ To have no economic value or cannot be developed or extracted due to regulatory, political, technological, spatial or market limitations, or changes in social and environmental norms.
- ⁷ According to Munich Re, in real terms, the average annual insurance losses due to weather-related events increased from \$10 billion in the 1980s to around \$50 billion in 2015 and extreme weather events have also tripled since the 1980s (NatCatSERVICE, 2015, 2018).
- ⁸ Wealth management is a subset of financial planning. Wealth managers are in essence, financial planners who work with a specific clientele: high net-worth individuals.

Chapter 3

Revenues of the EU ETS Auctioning and Their Impact on Budgetary Allocation: The Case of Poland

Kamilla Marchewka-Bartkowiak

 <https://orcid.org/0000-0001-5703-4189>

Poznan University of Economics and Business, Poland

Klaudia Jarno

 <https://orcid.org/0000-0001-9034-9246>

Poznan University of Economics and Business, Poland

ABSTRACT

This chapter offers insight into the role of EU ETS auction revenues from the perspective of a public sector and implementation of climate change policy rules. The final part of the chapter presents a detailed analysis of the Poland case in the years 2013-2019. The analyses conducted revealed that the revenues acquired from emission allowances auctioning impacted the state of public finance in Poland to a lesser degree than projected. At the same time, it was also revealed that the currently applied solution in Poland in terms of qualifying revenues from auctioning and spending funds in accordance with the provisions of Directive 2003/87/EC fails to be transparent and does not promote additionality of actions taken.

INTRODUCTION

Over the past two decades, the need to achieve an array of strategic environmental targets gave rise to the establishment of special financial and market mechanisms globally, supernationally (including the EU) and nationally. One of those mechanisms is the European Union Emission Trading System (hereinafter the EU ETS). The establishment of the auctioning of carbon emissions allowances also triggered the development of some other financial mechanisms in the public sector. On the one hand, the rules of the

DOI: 10.4018/978-1-7998-7967-1.ch003

Revenues of the EU ETS Auctioning and Their Impact on Budgetary Allocation

facility were aimed at introducing the mechanism of price competition, but on the other, they also offered public support in the form of providing financial support in funding environmental protection projects.

This chapter offers an insight into the role of EU ETS auction revenues from the perspective of a public sector and implementation of climate change policy rules. We use the case of Poland to illustrate a problem.

To achieve the research goal, we examine both the EU legislation and quantitative data on Poland's budgetary revenues from auctioning of carbon permits and its expenditures on climate protection. We have sourced data from the European Energy Exchange (hereinafter EEX), ICE Futures Europe, Poland's Ministry of Finance, Poland's National Fund of Environment Protection and Water Management (hereinafter NFEP&WM), and EIONET. The time frame of our analysis is 2013-2019.

We organise our discussion as follows. The next section provides a review of previous studies on allocation of EU ETS auction revenues. The subsequent sections introduce our research methodology and examine rules governing auctioning allowances under the EU ETS and present auctioning in practice. We then turn attention to the role of auction revenues within a state budget. We examine different models of auction revenues allocation. The final part of the chapter discusses the Poland case. We analyse amounts of auction revenues forecasted at the beginning of the third trading period, thus the expected effect of auction revenues on the state budget. The final part of the chapter offers a detailed analysis of Poland's auction revenues allocation model and the extent to which Poland meets the obligation to spend 50% of auction revenues on pro-climate actions.

LITERATURE REVIEW

The debate over the use of auction revenues started at the very beginning of the EU ETS operations. Müller (2008) summarised the first rounds of negotiations between EU member states and EU bodies over the extent to which auction revenues should be earmarked for climate change purposes and discussed points highlighted by both followers and opponents of earmarking as well as presented some countries' experience with earmarking in public finance.

Marchewka-Bartkowiak (2012) focused on possible allocation models of auction revenues and differentiates between directing auction revenues to the state budget and channelling them into a specially dedicated environmental fund.

Löfgren et al. (2018) compared auction revenues across EU member states and investigated the directions of auction revenues spending using EIONET data. They found that when spending their auction revenues, EU countries generally favoured energy efficiency projects and promotion of renewable energy sources (the same conclusion was drawn from a similar study that utilised EIONET data of Quatrosi (2018)), though there was a great diversity between countries. The researchers concluded it was impossible to completely review spending of auction revenues within the EU because of some obstacles. First, they stressed big differences between countries when it comes to amount of data reported. They also highlighted the lack of direct earmarking in many countries. Finally, they underlined that one was not able to assess the extent to which auction revenues crowd out funding of projects that would have been implemented without the revenues. Their findings regarding comparison difficulties are similar to those obtained by researchers that have prepared a report on auction revenues spending for the European Commission (Le Den et. al 2017).

The empirical studies discussed above focus on a problem of auction revenues earmarking from the perspective of public expenditures only. However, to gain a better understanding of auction revenues significance, it is important to evaluate carbon revenues in a broader context of a national public sector.

METHODS AND DATA

We opted for a qualitative case study approach (Yin, 2003) and strived to assess the Poland's approach to auction revenues allocation. Poland occupies a special place in the EU's climate policy conceptualisation and operationalisation. It is a relatively big economy and its energy system is dependent on coal to a great extent at the same time (Eurostat, 2020). Thus, Poland faces a big challenge to transform its energy system towards greener one. From this point of view, Poland serves as a good benchmark for assessing effectiveness of all the tools and mechanisms aimed at enhancing low-carbon investments.

Our research design was multi-step. First, to ensure comprehensiveness of our study we outlined the setting for auctions of allowances and allocation of auction revenues under the EU ETS, i.e. regulations governing auctioning CO₂ allowance under the EU ETS as well as current practice of auctions. The data sources utilised included the UE legislation and the data provided by the European Energy Exchange and ICE Futures Europe. Then, based on Marchewka-Bartkowiak (2012) we presented two main models of CO₂ allowances auctioning revenues allocation and then defined Polish auction revenues allocation model in the next step through this pre-existing theoretical lens in line with the deductive content analysis (Marying, 2004). Our research strategy was to collate data from different and unconnected primary and secondary sources: the Polish Ministry of Finance, the European Energy Exchange, the EIONET and the Poland's National Fund of Environmental Protection and Water Management to gain a holistic view of Polish allocation model and its implications on both the state of public finance and environmental protection. The time range of our analysis is from 2013 to 2019 (7 years period).

THE FORMAL AND LEGAL CONDITIONS FOR AUCTIONING ALLOWANCES UNDER THE EU ETS

The European Union Emission Trading System was established under Directive 2003/87/EC and its launch took place in 2005. The system works under the cap and trade model, i.e. an overall limit of greenhouse gases is set, reflecting the amount of emission allowances that are tradable. The entities covered by the system (greenhouse gas emitters that meet certain criteria) must surrender a number of allowances equal to the total emissions from that installation over a given period. Allowances can be acquired through primary allocation or in the secondary market. The system not only allows controlling the total amount of greenhouse gases emitted by the entities covered by the mechanism, but it also encourages them to implement low carbon technologies for an alternative way to purchasing additional allowances is through carbon emission reduction (Jarno, 2017).

2009 saw the adoption of the so-called climate and energy package, i.e. a collection of legal acts that gave shape to the European climate policy until 2020. Part of the package is Directive 2009/29/EC which reformed the EU ETS including a change in the rules of primary allocation in the so-called third trading period (2013-2020).

Revenues of the EU ETS Auctioning and Their Impact on Budgetary Allocation

In the first two trading periods (2005-2007 and 2008-2012), member states distributed most or all of their allowances free of charge. The prevailing method for primary allocation of allowances was the so-called grandfathering, i.e. a free-of-charge distribution of allowances on the grounds of historic emissions. Grandfathering, as a method of primary allocation of allowances, comes under a lot of criticism as it rewards past emissions and inefficiency (Costanza et al., 1997; Bergland, Clark and Pedersen, 2001). In other words, grandfathering rewards those who have already had their share in excessive concentration of greenhouse gases in the atmosphere.

An alternative to grandfathering as a means of allocating allowances is auctioning. In auctions, allowances are purchased by those entities which are willing to pay the highest price at the given time. Therefore, auctions are believed to encourage innovations and serve as the most efficient way of allowances distribution. Auctioning excludes extraordinary gains and does not undermine the position of new entrants and those which grow faster than the market average (Directive 2009/29/EC).

During the third trading period, most emission allowances are auctioned, with a number of differences between certain industries in this respect. In principle, from 2013 onward, full auctioning should be executed for the power sector. However, derogation to this rule leaves out installations located in EU member states, meeting certain criteria (1), on condition that they were operational before 31 December 2008, or the investment process was launched precisely on that day at the latest. The aim of the transitional period of free allocation of allowances to those installations was to allow modernising energy production during that time. During the third trading period, entities in sectors qualified as liable to the so-called carbon leakage obtain allowances free of charge (100%). Over the years, operators of installations in the other sectors, i.e. not covered by derogation or not qualified as threatened with carbon leakage, have been buying an increasing amount of allowances in auctions (20% in 2013, 80% in 2020, 100% in 2027; Directive 2009/29/EC).

Under the EU ETS, allowances are auctioned by a particular member state, and the financial resources obtained from the auctions remain at the disposal of the auctioning state. Less developed EU states became privileged in terms of the amount of the auctionable allowances (the amount exceeds that of their actual share in EU emissions) with a view to encouraging relatively greater efforts of those states to achieve greater energy efficiency. Only 88% of the total amount of auctionable allowances are allocated among EU states in the proportions corresponding to their actual share in emissions covered by the EU ETS. 10% of allowances are auctioned by member states that meet the 2005 GDP per capita criterion, while the remaining 2% are auctioned by states with 2005 emissions lower by 20% than in the Kyoto protocol base year (Directive 2009/29/UC).

ALLOWANCES AUCTIONING IN PRACTICE

With a view to reducing the administration costs of the mechanism, conducting the auctions by means of a common auction platform is a preferred solution. Nevertheless, member states are provided for the possibility to opt-out of the common auction platform by appointing their own auction platforms (Commission Regulation (EU) No 1031/2010). Until now, only three states (Germany, Poland, the UK¹) have declared to select an auction platform by themselves.

The common auction platform is run by the European Energy Exchange (hereinafter EEX) based in Leipzig. In an auction, on offer are allowances submitted for sale on the given day by all EU member states, except Germany, Poland and the UK. Germany and Poland carry out auctions via the EEX too.

Revenues of the EU ETS Auctioning and Their Impact on Budgetary Allocation

However, their auctions include allowances at the disposal of their own states only. The allowances of the UK were auctioned via the ICE Futures Europe platform, based in London.

All auctions of allowances are price auctions. Bidders place their bids stating the number of allowances and the proposed price. After collecting all bids, they are sorted by their price range, starting from the highest. The bids are accepted in the aforementioned order, until they run out. All accepted bids are settled at the price (the so-called clearing price) of the last accepted bid (Commission Regulation (EU) No 1031/2010).

The EUA (2) auctions are held regularly (cf. Table 1). Regardless of the auctioning state, the currency of all auctions is euro (EUR), and the auctions are of similar nature.

Table 1. The organisation of emission allowances auctions

	Germany	Poland	The UK	The other EU member states, Innovation Fund, and Modernisation Funds
Platform	EEX	EEX	ICE Futures Europe	EEX
Currency	EUR	EUR	EUR	EUR
Frequency – EUA auctions	Every week	Every two weeks	Every two weeks ²	Three auctions a week
Clearing	t+1	t+1	t+2	t+1
Minimum lot size	500	500	500	500
Tick size	0.01 EUR/allowance	0.01 EUR/allowance	0.01 EUR/allowance	0.01 EUR/allowance
Combined trading and clearing fee	3.5 EUR/1000 allowances	3.38 EUR/1000 allowances	0.2 EUR/500 allowances	3.38 EUR/1000 allowances
Fulfilment	Delivery versus payment	Delivery versus payment	Delivery versus payment	Delivery versus payment

Source: EEX 2021 and ICE Futures Europe 2021.

EUAA (3) auctions are decidedly rarer. For instance, in 2019, Poland, just like Germany and the UK, conducted only one EUAA auction. In that period, six EUAA auctions were held, available to all the other EU member states.

MODELS OF ALLOCATION

Directive 2009/29/EC introduced a very clearly stated budgetary rule under which at least 50% of revenues obtained through the auctioning of carbon allowances ought to be spent on domestic or foreign pro-climate actions, particularly those addressing the issue of adaptation to climate change, financing research and development into emission reductions, the development of renewable energy sources, and investments into capturing and storing greenhouse gases. Furthermore, the resources can also be spent on projects that prevent deforestation, accelerate adaptation to climate change in developing countries,

Revenues of the EU ETS Auctioning and Their Impact on Budgetary Allocation

and address the so-called social issues, i.e. compensation, including curbing the costs of the increased energy prices affecting households with low and medium income (Directive 2009/29/EC).

Under the aforementioned provisions of the European legislation, it is EU member states themselves that decide about the ways of allocating the revenues obtained through the auctioning of emission allowances to meet the 50% proviso. However, there do not exist any detailed recommendations regarding the registration and the allocation of funds in the state budget.

Therefore, we should recognise two potentially most beneficial ways of the possible registration of revenues obtained through the auctioning of emission allowances (Figure 1), i.e. as (Marchewka-Bartkowiak, 2012):

- budgetary revenues
- a source of financing a specially dedicated (earmarked) state fund.

It should also be noted that the revenues acquired through emission allowances auctioning are of changeable nature, depending on the market price of the allowance units, which can have an adverse impact on the planning and implementation processes within the annual budget.

The most important form of registering the acquired funds as budgetary revenues should be considered in two variants (Marchewka-Bartkowiak, 2012).

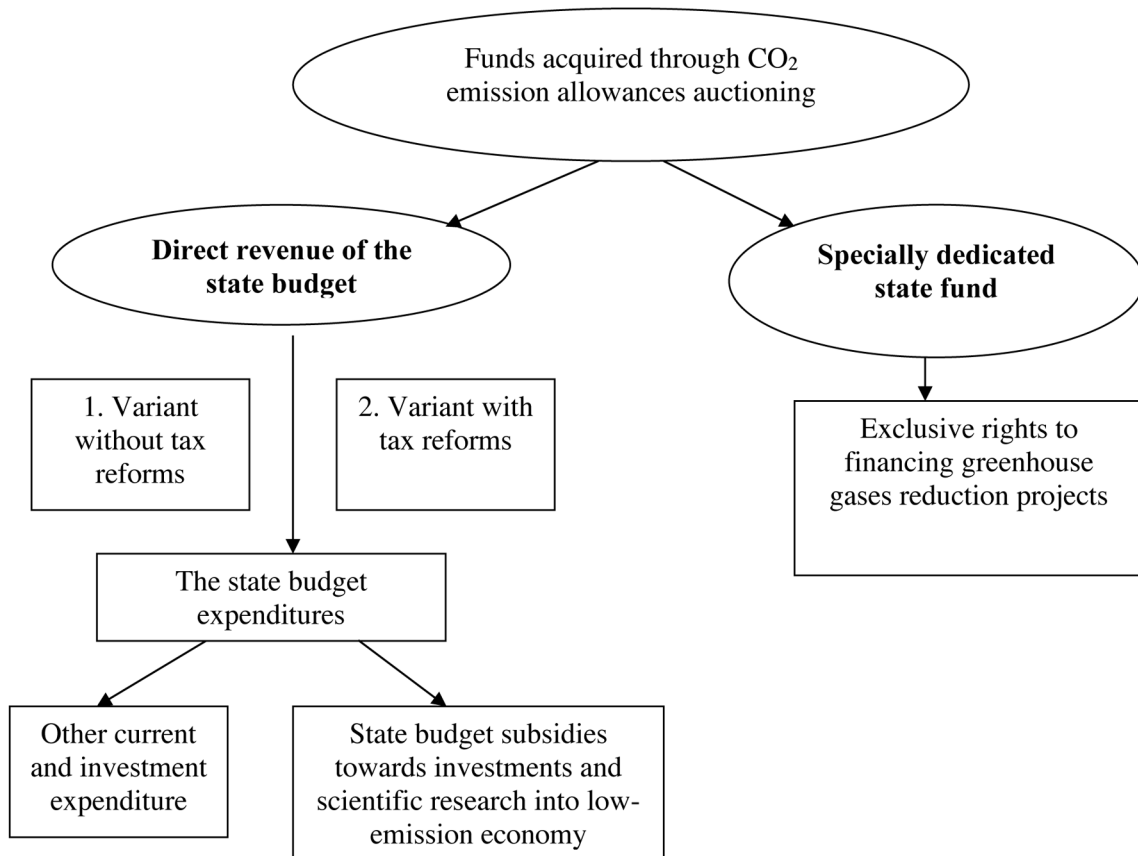
Under one of them, the increase in revenues acquired through auctioning is accompanied by changes in the tax system resulting from the adopted priorities concerning their allocation. On the one hand, they concern the compensation of the forecasted increase in electricity prices (as the power sector needs to buy carbon allowances) e.g. through abatement of indirect taxes (e.g. VAT) and/or income tax, or increase in tax reliefs. On the other hand, changes in the tax system are devised to promote the implementation of climate protection investments that are indispensable in the power sector, which should also bring about lesser increases in energy prices. Tax reliefs should involve those enterprises which are required to incur relatively high investment costs towards adjusting their production methods to the low emission requirements. Therefore, auction revenues ought to be of complementary nature within the changes in the structure of budgetary revenues resulting from the shift to low carbon economy (Marchewka-Bartkowiak, 2012).

The other variant of the revenues solution stipulates no changes in the tax system whatsoever. A premise in favour of taking no reforms in this respect could be the fact that the budget is required to incur high economic costs of implementing the climate and energy package in the form of a decrease in GDP and increase in the unemployment rate. According to the 2011 forecast of the World Bank for EU member states, the implementation of emissions reduction targets would result in an average decrease of the real GDP by ca. 0.6%, with the unemployment rate rising by 0.2% (Proposal for a Council Directive COM(2011)169/3). Hence, the additional revenues from auctioning emission allowances should be regarded as filling the income gap that accompanies those phenomena, particularly when it comes to the ever-present problems of financing budgetary deficits (Marchewka-Bartkowiak, 2012).

Another possible way to register resources obtained through the auctioning of carbon emission allowances is to pass them (all or part) to a specially dedicated (earmarked) public fund that deals with the financing of operations and investments that cover the targets of climate policy. Launching an earmarked fund that collects financial resources obtained through the auctioning of emission allowances makes it more possible to channel them towards the implementation of specific projects, primarily investments (including research) in pushing the shift towards a low carbon economy. However, it is important to

define in detail the tasks of funds of this type and provide a legal and organisational basis for launching a comprehensive programme of financing ecological investments (Marchewka-Bartkowiak, 2012).

Figure 1. The variants of the allocation of funds acquired through CO₂ emission allowances auctioning
 Source: Marchewka-Bartkowiak, 2012 (modified)



To sum up, it should also be noted that under Directive 2009/29/EC, EU member states are obliged to systematically inform the EC on how they use the revenues from emission allowances auctioning and how public authorities spend the 50% at their disposal. Limited transparency in this respect can hamper successful verification and assessment of how advanced particular member states and the whole of the EU are in meeting climate targets. Detailed budgetary data on the adopted rules of public financing of the climate policy are also needed within the system of the integrated economic accounts of the environment (4).

EXPECTED EFFECT OF THE AUCTIONING MECHANISM ON PUBLIC SECTOR

At the time of launching the auctioning mechanism, the European Commission's estimate was that by 2020 the auction system could generate annual revenues of 20-50 bn EUR, depending on the changes in the emission reduction costs and the accompanying fluctuations of allowances prices (Marchewka-Bartkowiak, 2012).

In 2011, two independent research centres presented their preliminary simulations of budgetary revenues from auctioning, as anticipated for 2020. A report by the British organisation Climate Strategies (Cooper et al., 2011) showed, among other things, that over eight consecutive years since the launch of the third EU ETS phase, within the energy sector itself, the total revenues across all EU member states might amount to 145-295 bn EUR, and as much as 360 bn EUR including all sectors covered by the mechanism. Furthermore, a report developed under the Think project (Olmos et al., 2011) anticipated that the budgets of all EU member states could earn total revenues from the auctioning of emission allowances of 57-125 bn EUR, with Germany, Poland and the UK gaining the highest amounts.

Obviously, the forecasts were burdened with risk concerning the final arrangements into the determined pool of allowances auctioned since 2013 (and a pool of free allowances), the market price volatility of allowances, but also the uncertainty involved with the ever changing macroeconomic indicators of particular EU states. However, both the aforementioned predictions of the European Commission and the forecasts estimated by the think tanks suggested that the scale of the proceeds into the budgets of particular states should be considerable. Thus, the above presented amounts can serve as a benchmark of the efficiency of the mechanism in question, from the perspective of both the achieved scale of proceeds and the applied national rules of their allocation and the achieved results.

REVENUES FROM THE AUCTIONING OF CARBON ALLOWANCES AND THEIR ALLOCATION – THE CASE OF POLAND (2013-2019)

With a view to fulfilling the EU 20-20-20 strategic goals on climate policy, Poland, too, took the obligation to reduce greenhouse gases emission. One of the tools to achieve the reduction is participation in the EU ETS.

The first ever auction of EUAs conducted for Poland took place on 16 September 2013. In the years 2013-2019, a total of 96 EUAs and 5 EUAAs auctions were conducted (Table 2).

Table 2. The number of Polish auctions of carbon allowances

Year	2013	2014	2015	2016	2017	2018	2019
EUA auctions	14	3	6	7	19	23	24
EUAA auctions	0	0	1	1	1	1	1

Source: EEX 2021.

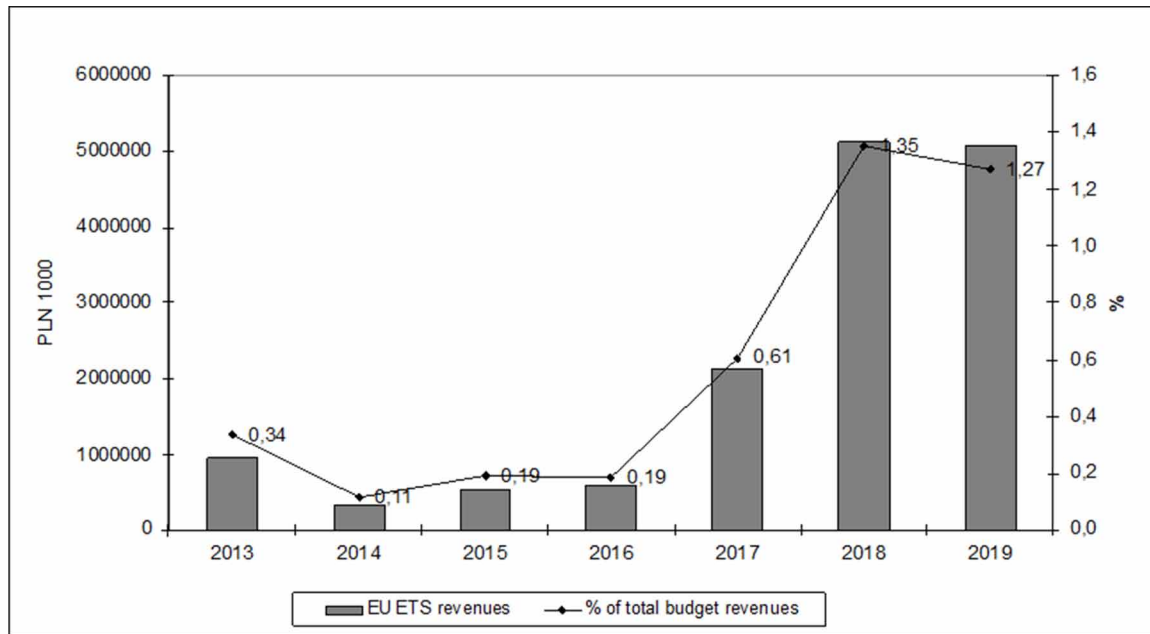
The frequency of the auctions, along with the number of the auctioned allowances and their prices, was directly reflected by the revenues achieved in the subsequent years. The highest revenues from the

Revenues of the EU ETS Auctioning and Their Impact on Budgetary Allocation

auctioning of carbon emission allowances were reported in 2018, while the lowest – in 2014. The share of total budgetary income in the total revenues of the state budget was changing over years ranging from 0.1% to 1.35% (Figure 2).

Figure 2. Budgetary revenues from EU ETS in total budgetary revenues

Source: authors' own work on the basis of the Poland' Ministry of Finance data.



Initially, year by year, the revenues obtained from the auctioning of allowances failed to meet the expectations of the government. The conclusions from the conducted analysis of budget drafts and implementation precisely indicate that in 2013, 2014 and 2016 budgetary revenues in question failed to achieve 50% of the anticipated amount. It was in 2015 and 2017 that revenues slightly exceeded the draft. However, in 2018 and 2019 the auction revenues strongly exceeded the draft. Thus, on average, in the years 2013-2019, budgetary revenues from EU ETS auctioning reached 121% of the draft (Figure 3).

The basic reason for not achieving expected revenues at the beginning of the period was lower than anticipated emission allowances price. Not without significance was also the fact that Poland obtained fewer emission allowances than expected. For instance, under EC (EU) Regulation 176/2014, the number of auctioning allowances was cut; as a result, instead of the anticipated 55.5 m in 2014 only 13.3 were ultimately auctioned (Ministry of Finance, Poland, 2016). The situation changed dramatically in 2018 and it should be attributed mainly to a sharp increase in average auction price (the price assumed for 2018 draft was 5.09 EUR while the real average price was 16.27 EUR). Furthermore, the Market Stability Reserve started to operate in September 2019 and because of it the volume of allowances auctioned by Poland until the end 2019 was higher than originally planned.

Revenues of the EU ETS Auctioning and Their Impact on Budgetary Allocation

Figure 3. Budgetary revenues from EU ETS auctioning (draft and reported)

Source: authors' own work on the basis of the Poland' Ministry of Finance data.

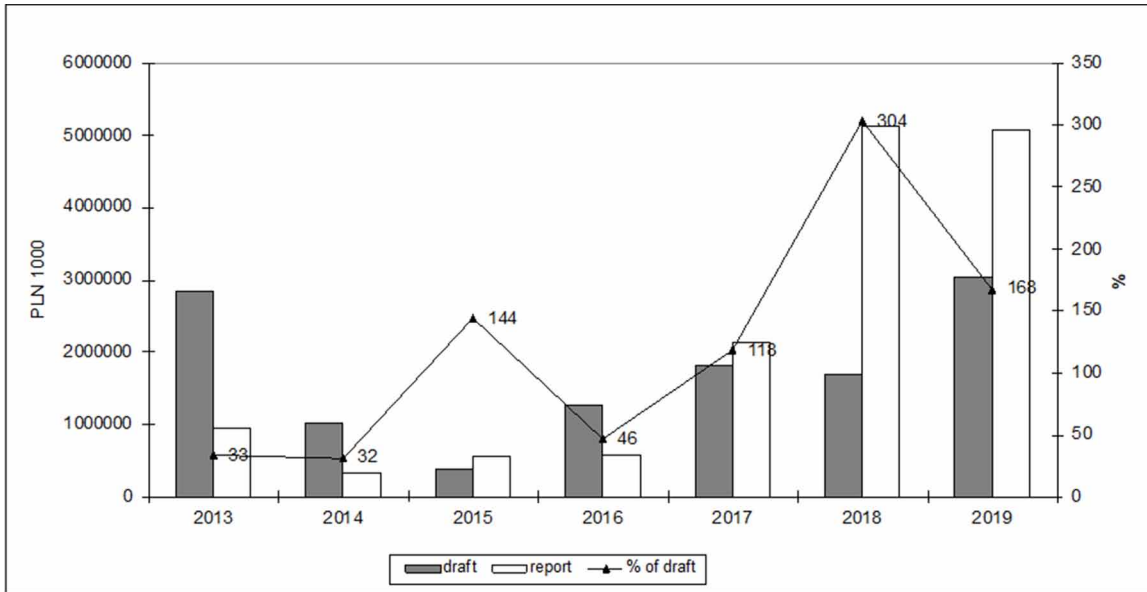
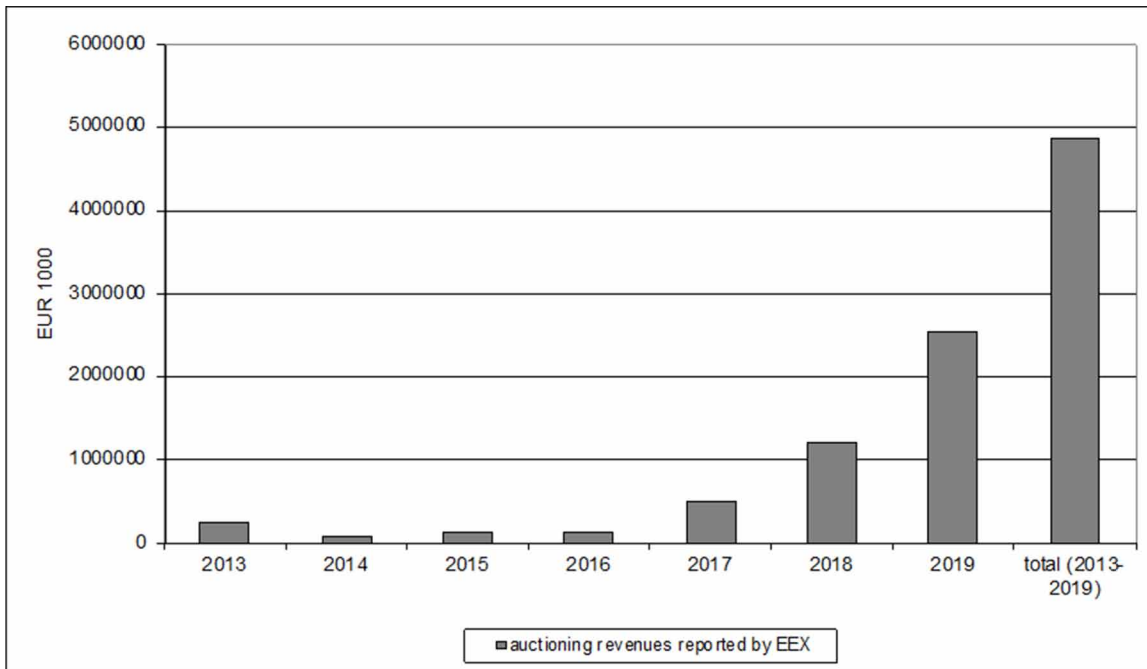


Figure 4. EU ETS revenues

Source: authors' own work on the basis of EEX data.



Revenues of the EU ETS Auctioning and Their Impact on Budgetary Allocation

To sum up, the total amount of revenues from the auctioning of emission allowances in the years 2013-2019 reached ca. 4.9 bn EUR. According to the Think report, in Poland in 2020, average budgetary revenues from the auctioning of emission allowances should amount to ca. 10 bn EUR (i.e. about 6, 8 or 14 bn EUR, depending on the assumed price variant). However, the data provided by Climate Strategies suggest that the revenues could be even twice as high. All in all, despite the sensational results in the recent years Poland will at most follow the minimum scenario.

Another important issue to consider is the assessment of the Poland-adopted organisational model of allocation of the funds in question. Under the adopted regulations, all the financial resources obtained through the auctioning of emission allowances belong to the state budget. However, at the same time there exists a specially dedicated (earmarked) fund – the National Fund for Environmental Protection and Water Management (NFEP&WM (5)), established to finance a broad range of tasks covering environmental protection and water management, under the Act on Environmental Protection Law. To sum up, the Polish mechanism combines both the solutions, i.e. the flow of revenues from allowances auctioning through the state budget (under the second variant, i.e. without any major changes in the tax law), and the budget-subsidised proecological earmarked fund.

According to the principle of state budget unity, revenues are not matched with any particular expenditures. The 2017 European Commission’s report, covering the years 2013-2015, indicates that apart from Poland, a number of other EU member states, namely Austria, Denmark, Finland (in 2015), Ireland, Luxembourg, Malta, the Netherlands, Sweden and the UK (i.e. more than a third of EU member states) do not match particular expenditures with the revenues obtained through auctioning (Le Den et al., 2017). Nevertheless, all EU member states are obliged to report to the European Commission on their meeting the requirements of the EU ETS directive (Directive 2009/29/EC).

In its reports submitted to fulfil the above-mentioned obligation, Poland states clearly that the reported data cover only a part of the expenditures incurred, and which meet the requirements of the directive, and that the aim of those reports is to give evidence for meeting the requirement to spend 50% of the resources obtained through auctioning on climate protection activities (EIONET, 2021). Thus, the reports show the worth of those activities against the total revenues obtained through auctioning in a given year (the expenditures are given in EUR, using exchange rates provided in the report). The share of the total worth of the reported activities in the total revenues from auctioning in 2013-2019 is shown in Table 3.

Table 3. The share of Poland’s reported climate protection expenditures in auctioning revenues

	2013	2014	2015	2016	2017	2018	2019
Revenues from EUA and EUAA auctioning (thou. EUR)	244022	78010	132824	136142	505994	1202278	2548827
The worth of climate protection activities (thou. EUR)	128677	39024	68518	68087	290378	609927	1274413
The share of the activities in the total revenues from auctions	52.73%	50.02%	51.59%	50.01%	57.39%	50.73%	50,00%

Source: EIONET (2014-2020).

The reported revenues from allowances auctioning are identical to the total revenues from auctions conducted by Poland EUA and EUAA, reported by EEX. Importantly, none of the activities pointed to

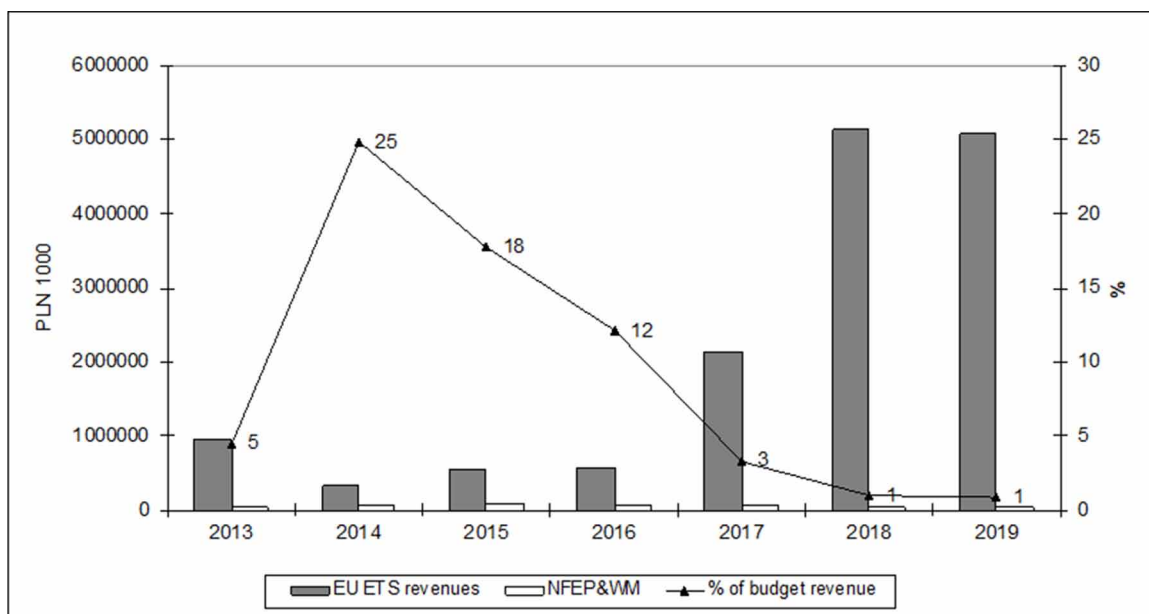
Revenues of the EU ETS Auctioning and Their Impact on Budgetary Allocation

by Poland is of international nature, nor are they aimed at providing support to developing countries. The national activities presented in the reports cover the programmes implemented by the NFEP&WM in the first place. For instance, in 2017 a list of 87 different activities was submitted, with 84 of them implemented by the NFEP&WM and its regional counterparts. However, in 2019 a list was much more comprehensive enumerating 20 activities only (of which 16 activities were regarding the same initiative), with 18 of them implemented by the NFEP&WM.

In 2013-2019, the NFEP&WM obtained from the state budget an annual average of 9% of revenues acquired by the state budget from emission allowances auctioning. It is also worth noting that the highest level of grants against the revenues was reported in 2014 (when budgetary revenues from allowances auctioning were the lowest), while 2018 and 2019 saw the lowest level of grants (when budgetary revenues were the highest).

Figure 5. EU ETS budgetary revenues and the NFEP&WM proceeds

Source: authors' own work on the basis of Poland' Ministry of Finance and NFEP&WM (2014-2020) data.



Thus, the fund in question is only of complementary nature for it is the state budget that should cover investment and compensation actions, provided for in the EU directive, as the remaining part of the 50% rule.

It can also be proven that the stream of budgetary resources that finance the NFEP&WM is not used to cover all of its operations and investments implementation. As shown in Figure 6, in 2013-2019, budgetary grants accounted annually for an average of 3% of the fund's revenues. Under the enforced regulations, the revenues of the NFEP&WM consist mainly of environmental fines and penalties (Act of 27 April 2001).

Revenues of the EU ETS Auctioning and Their Impact on Budgetary Allocation

Figure 6. Budgetary grants to the NFEP&WM

Source: authors' own work on the basis of the Poland' Ministry of Finance and NFEP&WM (2014-2020) data.

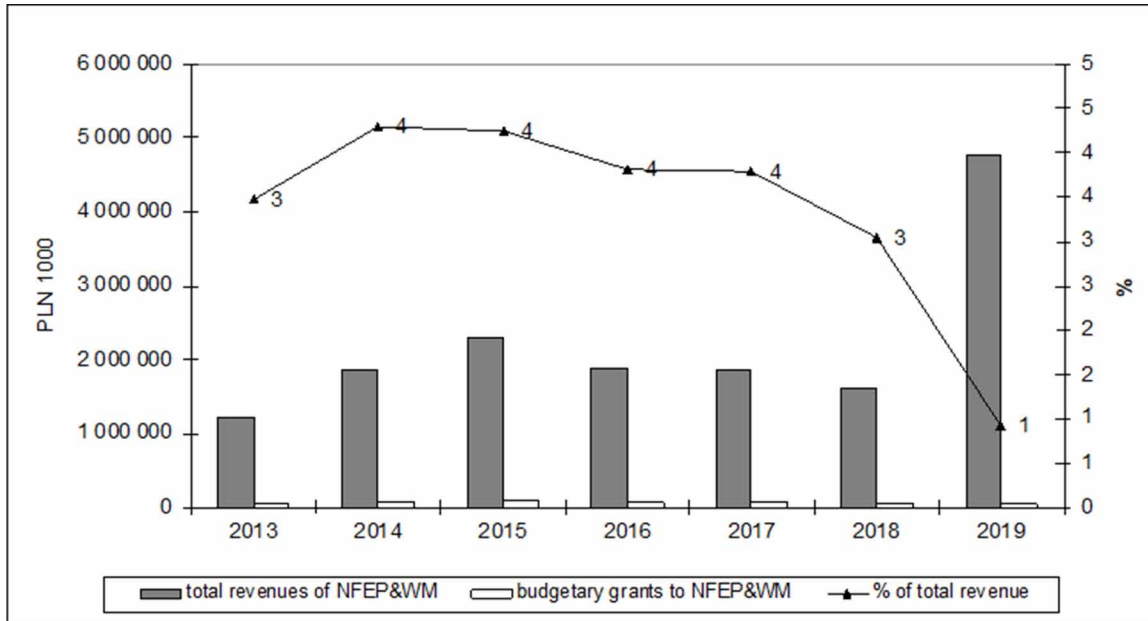
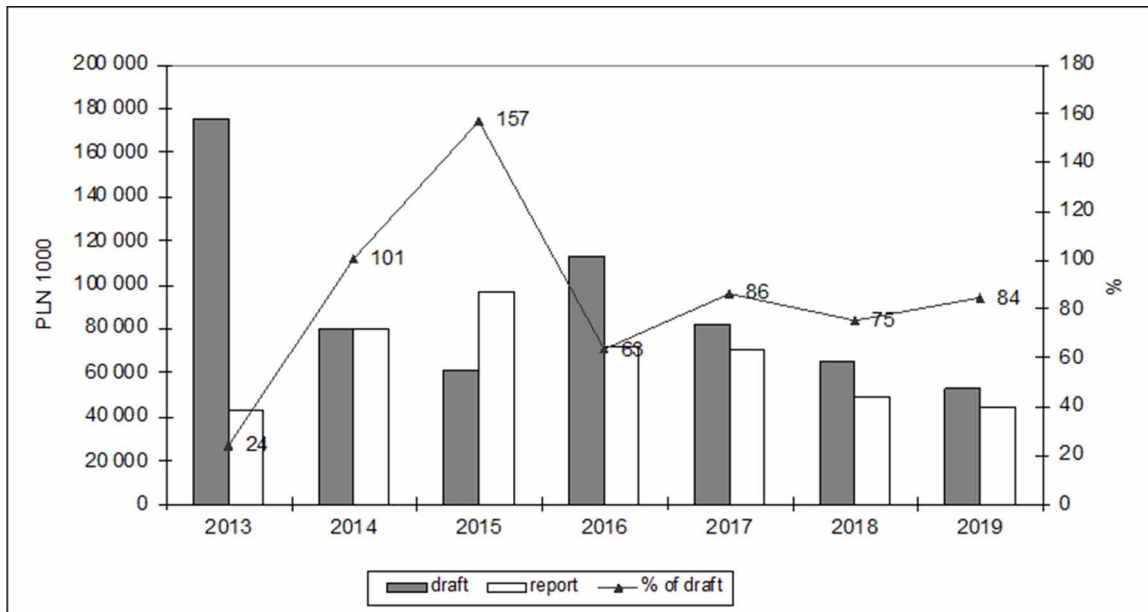


Figure 7. Budgetary grants to the NFEP&WM (draft and report)

Source: authors' own work on the basis of the Poland' Ministry of Finance and NFEP&WM (2014-2020) data.



Revenues of the EU ETS Auctioning and Their Impact on Budgetary Allocation

What is more, state budget grants did not always meet the plan. In the period under analysis, it was only in 2015 that the grant exceeded the draft. Then, in five other years the grant failed to meet the plan (Figure 7).

Budgetary grants to the NFEP&WM were primarily used towards: providing technical assistance in EU projects, financially supplement the costs of international projects, financing consultative programmes, and the so-called system correction. This means that the actions taken by the NFEP&WM under the 50% rule, as reported by Poland, were financed from other sources than revenues from emission allowances auctioning.

Table 4 presents a summary of the course of actions reported to the European Commission by Poland, along with examples of specific initiatives, with respect to the adopted fiscal rule in 2013-2019.

Table 4. The course and examples of actions taken by Poland, reported with respect to expending the 50% of revenues from EU ETS auctions in 2019

Course of action	Examples of action		
	The NFOE&WM	The Ministry of Finance	The Ministry of Energy
Covering administrative expenses related to the management of the emissions trading system	Financing the activities of the KOBiZE institute	-	-
Development of renewable energy sources	Co-financing of photovoltaic micro-installations	Exemption from energy tax if electricity produced from renewable energy sources	Financial support for producers of energy from renewable sources corresponding to the market value of green certificates cancelled in 2018
Development of other technologies promoting safe and sustainable low emissions economy	<ul style="list-style-type: none"> - Grants for exchange of heat sources in single-family houses - Financing the replacement or liquidation of heat sources and thermo-modernisation of single-family residential buildings if owners are at risk of energy poverty - Tax relief for the thermal modernisation of buildings 	-	-

Source: authors' own work on the basis of: EIONET (2020).

In the end of July 2019, the Minister of Environment submitted to the Council of Ministers the document that includes the recommendations for changes in primary allocations and distribution of auction revenues in the post-2020 period. The document advocates selling all the CO₂ emission allowances available to Poland on auctions and putting proceeds from the sale of 275 mln CO₂ emission allowances in a newly established specially dedicated fund that will aim at modernisation of energy sector. The Minister of Energy (currently the Minister of State Assets) will have responsibility over the fund (Premier.gov.pl, 2019). If these recommendations are implemented in practice, the Poland's organisational model of the allocation of funds acquired through the auctioning will be altered. The biggest change will be direct assignment of proceeds from auctions to the specially dedicated fund. Such a solution will favour additionality of projects undertaken to a higher extent than the existing model.

CONCLUSION

Without doubt, the mechanism of auctioning CO₂ emission allowances – the subject of our analysis – made it necessary to match political and financial decisions with the implementation of strategic environmental goals. However, it is unlikely that the primary financial goals for 2020 can be met. In the case of Poland, the very optimistic preliminary scenarios on EU ETS budgetary impacts will be hard to fulfil in the target year 2020.

One of the obstacles could be the limited evaluation of the efficiency of the mechanisms of allocating public funds obtained from emission allowances auctioning in particular countries. Despite the many market solutions attached to it, it still is a segment that was created “artificially” and in a broad political context. Both the financial and environmental efficiencies are in question. A further investigation is needed in this regard.

It is also arguable to what extent the organisational model of the allocation of funds acquired through the auctioning of emission allowances in Poland, and the course of spending those resources, contributes to the additionality of the actions taken, i.e. would those actions still be taken if there no were revenues acquired. The scope of additionality of the current system is another potential avenue for further research.

To sum up, it is worth promoting standardisation and improved transparency of national reporting to EU institutions so that it becomes possible to evaluate the implemented organisational mechanism and the real (investment) results of the proecological actions taken.

Notes:

- (1) Member state must meet one of the following requirements: 1. The national power grid was not connected to the common grid in 2007, 2. In 2007, the national power grid was connected to the common grid with a single transmission line of 400, or less, MW. 3. The share of energy produced from a fossil fuel of one type in the energy balance was at min. 30%, and GDP per capita was at max. 50% of average GDP per capita across the EU.
- (2) European Union Allowance, basic allowance to emit 1 t of carbon dioxide under the EU ETS.
- (3) European Union Allowance, basic allowance to emit 1 t of carbon dioxide under the EU ETS aimed at aircraft operators only.
- (4) The System of Environmental-Economic Accounting (SEEA) developed jointly by the United Nations, the European Commission, the International Monetary Fund, the Organisation for Economic Cooperation and Development, and the World Bank is a system of satellite accounting against the System of National Accounts (SNA) – Regulation (EU) No 691/2011.
- (5) Along with its regional counterparts.

REFERENCES

Act of 27 April 2001. Environmental protection law, Journal of Laws 2001 no 62 item 627.

Bergland, H., Clark, D. J., & Pedersen, P. A. (2001). Rent Seeking and the Regulation of a Natural Resource. *Marine Resource Economics*, 16, 219-233. Retrieved from <https://www.jstor.org/stable/42629320?seq=1>

Revenues of the EU ETS Auctioning and Their Impact on Budgetary Allocation

Bloomberg. (2020). *EU Carbon Market Has Chance to Link With U.K. After Brexit Deal*. Retrieved from <https://www.bloomberg.com/news/articles/2020-12-28/eu-carbon-market-has-chance-to-link-with-u-k-after-brex-it-deal>

Commission Regulation (EU) No 1031/2010 of 12 November 2010 on the timing, administration and other aspects of auctioning of greenhouse gas emission allowances pursuant to Directive 2003/87/EC of the European Parliament and of the Council establishing a scheme for greenhouse gas emission allowances trading within the Community. OJ L 302, 18.11.2010, 1-41.

Cooper, S., Grubb, M., Rysanek, A., & Laing, T. (2011). *Revenue dimensions of the EU ETS Phase III. Climate Strategies*. Retrieved from <https://climatestrategies.org/wp-content/uploads/2011/05/cs-revenues-phaseiii-final.pdf>

Costanza, R., Cumberland, J., Daly, H., Goodland, R., & Norgaard, R. (1997). *An Introduction to Ecological Economics*. CRC Press. doi:10.1201/9781003040842

Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC. OJ L 275, 25.10.2003, 32-46.

Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community. OJ L 140, 5.6.2009, 63-87.

EEX. (2021). *EU ETS Auctions*. Retrieved from <https://www.eex.com/en/markets/environmental-markets/eu-ets-auctions>

EIONET. (2014-2020). *Overview Art. 17 - Use of auctioning revenue and project credits*. Retrieved from http://cdr.eionet.europa.eu/Converters/pl/eu/mmr/art17_auctioning/

Ernst & Young. (2008). *Synteza analiz dotyczących skutków społeczno-ekonomicznych pakietu energetyczno-klimatycznego UE*. Author.

Eurostat. (2020). *Shedding light on energy in the EU. A guided tour of energy statistics*. Retrieved from <https://ec.europa.eu/eurostat/cache/infographs/energy/>

Futures Europe, I. C. E. (2021). *EUA UK Auction*. Retrieved from <https://www.theice.com/products/18997864/EUA-UK-Auction-Daily-Futures>

Jarno, K. (2017). *Carbon funds in climate policy*. Warsaw: CeDeWu.

Le Den, X., Beavor, E., Porter, S., & Iliescu, A. (2017). *Analysis of the use of Auction Revenues by the Member States*. European Commission. Retrieved from https://ec.europa.eu/clima/sites/clima/files/ets/auctioning/docs/auction_revenues_report_2017_en.pdf

Löfgren, A., Burtraw, D., Wråke, M., & Malinovskaya, A. (2018). Distribution of Emissions Allowances and the Use of Auction Revenues in the European Union Emissions Trading System. *Review of Environmental Economics and Policy*, 12(2), 284–303. doi:10.1093/reep/rey012

Marchewka-Bartkowiak, K. (2012). Wpływy budżetowe ze sprzedaży uprawnień do emisji gazów cieplarnianych w systemie ETS oraz możliwe warianty ich alokacji. *Studia BAS*, 29, 137-159. Retrieved from [http://orka.sejm.gov.pl/wydbas.nsf/0/9FC095BC342E685BC1257A2A0045B8BF/\\$File/Strony%20odStudiaBAS\(29\)_I-7.pdf](http://orka.sejm.gov.pl/wydbas.nsf/0/9FC095BC342E685BC1257A2A0045B8BF/$File/Strony%20odStudiaBAS(29)_I-7.pdf)

Mayring, P. (2014). *Qualitative content analysis: Theoretical foundation, basic procedures and software solution*. Klagenfurt, Austria: SSOAR. Retrieved from <https://www.ssoar.info/ssoar/handle/document/39517>

Ministry of Finance, Poland. (2014-2020). *State Budget Report*. Retrieved from <https://mf-arch2.mf.gov.pl/en/web/bip/ministry-of-finance/state-budget/revenue-expenditure-deficit-execution/>

Müller, B. (2008). *To Earmark or Not to Earmark? A far-reaching debate on the use of auction revenue from (EU) Emissions Trading*. Oxford Institute for Energy Studies EV 43. Retrieved from <https://www.oxfordenergy.org/wpcms/wp-content/uploads/2011/03/EV43-ToEarmarkorNottoEarmarkAfar-reaching-debateontheuseofauctionrevenuefromEUEmissionsTrading-BMuller-2008.pdf>

NFEP&WM. (2014-2020). *Sprawozdanie z działalności Narodowego Funduszu Ochrony Środowiska i Gospodarki Wodnej*. Retrieved from <https://www.nfosigw.gov.pl/o-nfosigw/organizacja-i-dzialalnosc/sprawozdania-z-dzialalnosci/>

Olmos, L., Ranci, P., Paziienza, M. G., Ruester, S., Sartori, M., Galeotti, M., & Glachant, J. M. (2011). *The impact of climate and energy policies on the public budget of EU member states, Final Report*. Think. Retrieved from <https://op.europa.eu/en/publication-detail/-/publication/f42f283e-8d56-49e4-8ca8-c95e7bddaa5c/language-en>

Premier.gov.pl. (2019). *Dokument: System EU ETS po 2020 r. – rekomendacje*. Retrieved from <https://www.gov.pl/web/premier/dokument-system-eu-ets-po-2020-r--rekomendacje>

Proposal for a Council Directive amending Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity, COM(2011)169/3.

Quatrosi, M. (2017). EU ETS revenues and member states investment strategies. *Economics and Policy of Energy and the Environment*, 2017(3), 41–57. doi:10.3280/EFE2017-003003

Regulation (EU) No 691/2011 of the European Parliament and of the Council of 6 July 2011 on European environmental economic accounts, OJ L 192, 22.7.2011, 1–16.

Yin, R. K. (2003). *Case study research, design, and methods*. SAGE.

ENDNOTES

- ¹ Since the 1st February 2020 the United Kingdom has withdrawn from the EU but during the transition period (until the end of 2020) all the EU laws fully applied to and in the United Kingdom (it follows that stationary installation and aircraft operators were obliged to fulfil their EU ETS obligations for 2020 and to surrender a proper number of allowances until the end of April 2021). That is why authors decided to include the United Kingdom in this analysis. After the end of transi-

Revenues of the EU ETS Auctioning and Their Impact on Budgetary Allocation

tion period, the EU governing rules no longer apply to the United Kingdom. However, the United Kingdom intends to pursue emission reduction targets and to set up its own cap and trade system and to link it to the EU ETS (Bloomberg 2020).

- ² In 2021 auctions take place on the weekly basis.

Chapter 4

SDG 13 and Environmental Governance in the Nigerian Financial Sector

Temiloluwa O. Akinsola

Bowen University, Nigeria & University of Johannesburg, South Africa

Michael Olajide Adelowotan

University of Johannesburg, South Africa

ABSTRACT

This chapter examines how the board of directors of financial organisations and the regulatory bodies have responded to climate change as it has occurred over time, with particular reference to the banking sector in Nigeria. It reflects on the Sustainable Development Goal (SDG) 13, which is about taking urgent action to combat climate change and its impacts by both banks and government regulatory organisations. The chapter is hinged on the triple-bottom line theory and considered various existing international environmental initiatives, and how Nigerian banks have responded to them. The chapter concludes that though a lot has been done by the Nigerian banks to act on initiatives towards climate change, there is more to be done on the part of the board of directors and the regulatory authorities of the listed banks considered.

INTRODUCTION AND BACKGROUND

As the world moves gradually to adapting to the recent disruption, it is imperative to state that climate change did not stop its impact as other economic activities recessed during the global disruption. This is to emphasise the importance of climate action on the well-being of people and economic activities, as it does not cease its actions till there is an intentionality to reverse it (Oteh & Sanni, 2021). Some scholars (Gössling & Scott, 2018; Park & Kim, 2020; Zhang et al., 2020) affirmed that climatic change issues are caused by human factors and activities. This means that man is also capable of taking remedial actions aimed at preventing the looming adverse effects of climate change on the planet earth. This chapter,

DOI: 10.4018/978-1-7998-7967-1.ch004

SDG 13 and Environmental Governance in the Nigerian Financial Sector

therefore, explores how the leadership of corporate Nigeria in the financial sector is responding to the Sustainable Development Goal (SDG) 13 on climate action. The financial sector for the purpose of this chapter is narrowed down to banking subsector specifically, as against the insurance, asset management, pension fund, corporate financing subsectors.

The increase in climate change has not gone unnoticed throughout the globe, as different countries have experienced hurricanes, wildfire, great floods, mountain melting, heat waves, drought, and many other adverse environment activities as a result of extreme rise and fall in temperature, glacier melting, erratic rainfall, rising sea level and so on (Foundation myclimate, 2020). Over the years, various communities have experienced the adverse impact of climate change on their people and economy. Australia experiences wildfire, Texas was affected by Hurricane Harvey in 2017, forest fires in California, drought in Europe, and also in Morocco, Southern Africa was hit by Cyclone Eloise in 2021, Makurdi floods in Nigeria, and so on (OCHA, 2021; Banque de France, 2019; Cho, 2019; Isma'il & Kersha, 2018; Zhang et al., 2017).

Although agriculture, tourism, wildlife, infrastructure (the railway systems built near the sea level, and so on), health care are major sectors of the economy that climate change affects directly, the banking sector around the world is also impacted by it because of the exposure to credit risks, among other risks, through these sectors (Banque de France, 2019; Cho, 2019). According to Maama (2020), the financial sector does not have a direct relationship with climatic change as they carry out their day-to-day business of funds deposit, loan administration, risk management, wealth management, financial advisory, and so on. However, their activities in financing companies/businesses, whose activities impact climate change have a direct effect on the economy in general, which is in turn affected by climate change (Dlugolecki & Loster, 2003).

More importantly, there is increased awareness of the banks' financial, reputational and litigation risks concerning climate action financing. For instance, in 2016, the failure of a prominent bank in Australia to disclose risks of climate action in its annual reports led to litigation actions on the basis that investors were misled (Bradlow, 2019). Another climate-related risk faced by the banks is transitional risk, which is the risk of the economy moving from the traditional economic model to a climate-conscious one. This transition will pose various challenges to the economic model especially in terms of stranded assets and the adaptability of the banks themselves (Oguntuase & Ajibare, 2018). Banks began to take note of and address sustainability issues, by concentrating on their internal operations in the early 1990s. They aimed to reduce operating costs by energy conservation, non-wastage of water and materials like paper. They also decided to influence their clients and make them more environmentally responsible by decreasing related induced costs, thereby reducing their investment and lending risks (Weber & Feltmate, 2016).

The banks being a highly regulated sector, could not take steps wholly by themselves to mitigate these risks, however, central banks in various countries have taken steps in combating climate action through diverse reforms they introduced. For instance, the Bank of England pioneered educating other apex banks on the impact of climate change in the banking sector (Dikau & Volz, 2018). Also the *Banco Central do Brasil*, the apex bank of Brazil, issued amendments to its macro-prudential regulatory framework to incorporate green financing. In China, the People's Bank of China (PBC) launched thorough regulatory green policies for banks and other financial segments; *Banque du Liban*. The central bank of Lebanon, introduced the differential reserve requirements for the favourable allocation of credits for green financing. Bank Bangladesh and the Reserve Bank of India (RBI) are well known for aggressive green financing (Dikau & Volz, 2018). Maama (2020) showed that banks in countries in the Western part of Africa are making efforts to disclose on the environment as it affects them in their annual reports, as investors

request more information beyond the economic value of the organisations. Although the Nigerian banks are not mandated to report on carbon, they report on the environment, social and governance (ESG) in their annual reports (Maama, 2020).

Over the years, the financial sector generally has embraced the need for a more sustainable environment by encouraging impact investments, funding environmentally friendly projects, reporting on the drive for sustainability, identifying with global environmental initiatives and programs, and so on (Weber & Feltmate, 2016). The need for the funding of the SDGs brought the financial sector globally, among other organisations and nations into the agenda for the race to increased sustainability. The goals are to bring about the sustenance of green economy, as the environmental impacts were to boost global economic development (Weber, 2018).

Sustainable Development Goal (SDG) 13 – Climate Action

According to Weber (2018), the SDGs are initiatives that create a link between sustainable development and sustainable business matters, such as affordable and clean energy, responsible production and consumption, and at the same time enhance economic growth to create decent workplaces, sustainable cities and communities, among other goals. The Climate Action (SDG 13) is classified under the Biosphere group in the tripartite nested model of Rockström and Sukhdev (2016) and the sustainable scale in the elements of ecological economics categorization, alongside SDG 6 on Clean Water and Sanitation; SDG 14 on Life Below Water and SDG 15 that relates to Life on Land. This further explains its agenda of sustaining the planet (Szennay *et al.*, 2019).

According to the United Nations (2015), the SDG 13 aims to take urgent action to combat climate change and its impacts. It is targeted at the following issues:

13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.

13.2 Integrate climate change measures into national policies, strategies and planning.

13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.

13.a Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change (UNFCCC) to a goal of mobilizing jointly \$100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible.

13.b Promote mechanisms for raising capacity for effective climate change-related planning and management in the least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities.

These SDG targets are to be achieved by not only the developing countries as the Millennium Development Goals (MDGs) were intended, but by both the developing and developed countries by 2030.

The banking sector, locally and internationally, being financiers are also expected to aid the achievement of these targets (Kumar et al., 2016). According to Okonjo-Iweala (2020), Nigeria has a target of 30% renewable energy mix by 2030. As Nigeria aims and works towards this target, it is imperative to observe how well the banking leadership and their regulatory bodies are working in tandem with this goal. The research on climate action and the Nigerian financial sector is scarce (Oguntuase, 2017; Oguntuase & Ajibare, 2018) and more grounds are still available to be covered, especially in the area of governance, hence the importance of this chapter. It is also imperative to note that when the governance is gotten right, in terms of the board of directors and the regulatory authorities, the banks will have a smoother sailing in implementing green policies that can enhance their economic value and also translate to social good, going by the triple-bottom line theory.

This chapter is hinged on the triple-bottom line theory by Elkington (2004) that connects the environment with the financial life of the business and the society as a whole (Weber, 2018). According to Elkington (2018), the triple bottom line theory is a sustainability framework that considers the social impact and environmental effect on their economic outcomes. He further posits that the advancement in the manner in which social activities and the environment is focused on and treated by organisations should positively affect their economic life without majorly focusing on such economic outputs. The advancement of the Nigerian quoted banks with boards that place emphasis on climate change and environmental issues will consequently affect those banks and their immediate communities. The chapter puts into consideration all the fourteen (14) listed deposit money banks in Nigeria as they are the most popular financial institutions in the country and they have an unsegmented reach to the general populace and, hence, can influence the economy in a great manner. The regulatory bodies considered are the Central Bank of Nigeria (CBN), the Nigerian Deposit Insurance Corporation (NDIC) and the Securities and Exchange Commission (SEC).

The subsequent sections are on the global frameworks and initiatives on Climate Change. This is followed by the section on the efforts of Nigerian Banks in tackling Climate Change and then finally, Conclusion and Recommendation.

GLOBAL FRAMEWORKS AND INITIATIVES ON CLIMATE CHANGE

There have been various initiatives and frameworks introduced by different actors in environmental management to combat climate change and make the earth liveable. The financial sector also has various players that have developed sustainable initiatives and frameworks for this purpose as well. This section considers this, as major initiatives embarked upon and frameworks established on climate action financing, Greenhouse gas (GHG) emission control mechanisms, guidelines on global environmental credit management, and so on are looked into especially as it affects the banking industry.

Coalition for Environmental Responsible Economies (Ceres) Principles

The Coalition for Environmental Responsible Economies Principles is a non-mandatory code that was developed in the 1989 aftermath of major oil spillage from the Exxon Valdez oil tanker in the Gulf Coast of Alaska. It was formerly referred to as the Valdez Principles, it is a network of over eighty (80) corporate members, more than one hundred and thirty (130) non-governmental organisations, and seventy-five (75) institutional investors with assets worth over \$7 trillion. An organisation has to oblige

to a ten-point code of conduct that is listed within the Ceres principles to be validated by Ceres (Ceres, 2018; Lubber, 2019; Oserogho, 2020; Petersen, 2013). These ten-point principles include sustainable use of natural resources, protection of the biosphere, energy conservation, risk reduction, safe products and services, reduction and disposal of wastes, environmental restoration, management commitment, informing the public, and audits and reports (Srinivas, 2020).

The mission of Ceres is “to transform the economy to build a sustainable future for people and the planet”. This sustainability pursuit is hinged on four grounds – climate crisis, inequitable workplaces, water scarcity and pollution, and obsolete capital market systems (Ceres, 2018). Ceres is relevant to this chapter as it tackles the climate crisis experienced by the organisations that are its members and aims to make sustainability its bottom-line. Ceres is made up of international financial organisations like Citibank, PayPal, Amazon, to mention a few. Among the sectors that Ceres influences is the Banking and Finance sector (Ceres, 2018). Having co-introduced the Global Reporting Initiative (GRI), which is a well-known and globally accepted indicator for sustainability reporting (Petersen, 2013), it stipulates a global reporting guideline that helps organisations enhance their disclosures as it relates to environmental practices (Oserogho, 2020).

Equator Principle IV (EP)

This is one of the very essential voluntary and most prevalent standards in the global financial sector (Contreras et al., 2019). It is a guideline issued by the International Finance Corporation (IFC) and World Bank, in line with IFC’s Performance Standards (PS) and World Bank’s Environmental, Health & Safety (EHS) guidelines. It is a globally recognised framework for the management of environmental and social risks in helping to ascertain, assess and manage them in project-related transactions (The Equator Principles, 2020). This guideline on project finance, which is a means of funding large undertakings that involve energy, tourism and infrastructure projects, was established to assess the risks that relate to financing these projects and their impact on the environment (Weber, 2018). The EP has 10 principles that cover the risk management process for the A, B and C categorization of project financing from initiation to reporting stage. According to Equator Principles (2020), these projects are in categories according to their environmental and social effects. The most recent EP is the Equator Principles IV issued in 2020.

These principles are widely used in project finance, globally. Out of the one hundred and fourteen (114) financial institutions that have adopted the Equator Principles (EP), only four (4) of the listed banks in Nigeria (*EP Association Members & Reporting, 2020*) are on the list of the Equator Principles Financial Institutions (EPFIs) (See Appendix II). Owing to its voluntary nature, the law of the host country of the bank supersedes in case of clash or conflict in their principles and provisions.

Principles for Positive Impact Finance

The principles were developed by the Positive Impact Working Group, a group of UN Environment Finance Initiative banking and investment members, as the initial major step in putting into operation the roadmap outlined in the Positive Impact Manifesto in 2017. It is a set of voluntary guidelines provided to lead financial institutions and the businesses they serve to collaborate to eliminate the challenges of financing the SDGs (Contreras et al., 2019). This framework comprises four broad principles on positive impact financing that include definition, frameworks, transparency and assessment (UNEP Finance Initiative, 2017). This is a set of non-mandatory guidelines built on the foundations of the Equator Principles,

SDG 13 and Environmental Governance in the Nigerian Financial Sector

which is risk-focused, the Green Bond Principles, which is instrument-specific and aids investment in the financing of environmentally conscious projects, the Principles for Responsible Investment which is sector-specific, among others, to lead financial institutions and the businesses they serve to collaborate to eliminate the challenges of financing the SDGs (Contreras et al., 2019; UNEP Finance Initiative, 2017). These principles are also utilised by EPFIs when they are considering the financing of the SDGs.

Table 1. Equator principles

S/No	Principles
Principle 1	<i>Review and Categorization</i>
	Categorization of project that requires finance facilities based on the risk classifications (A, B and C)
Principle 2	<i>Environmental and Social Assessment</i>
	The requirement that clients applying for finance facilities must conduct environmental and social assessment when projects fall under categories A and B before facilities can be granted by banks that are signatories to EPs
Principle 3	<i>Applicable Environmental and Social Standards</i>
	An environmental assessment must take cognizance of the relevant laws and regulations of a particular country where a project is being financed with due regard to international conventions such as those of IFC and WHO
Principle 4	<i>Environmental and Social Management System and Equator Principle Action Plan</i>
	A client applying for project finance must also submit, in respect of Category A and B Projects, an Environmental and Social Management Plan to take care of any issues that may arise
Principle 5	<i>Stakeholder Engagement</i>
	Clients requiring finance must also show that they have in place a system where all stakeholders that might be affected are engaged continuously, in respect of projects in Category A and B to alleviate any negative effects the said projects might cause.
Principle 6	<i>Grievance Mechanism</i>
	Applicants for project finance must put in place a system where complaints and grievances on environmental and social issues from the affected stakeholders can be lodged and addressed
Principle 7	<i>Independent Review</i>
	There must be a system of review by an independent assessor to assess the level of compliance with issues relating to environmental standards
Principle 8	<i>Covenants</i>
	The applicant for project finance must pledge to abide by the process of assessment in the financing agreement and also submit regular reports as required
Principle 9	<i>Independent Monitoring and Reporting</i>
	For Categories A and B projects, an Independent Monitoring and Reporting professional must be kept by the one applying for project financing
Principle 10	<i>Reporting and Transparency</i>
	Banks providing project finance will provide an annual report to the public on such transactions and their actual observations on their clients' performance

Source: (Oghojafor and Aduloju, 2020, as adapted from Johnson, 2014)

United Nations Environment Programme Finance Initiatives (UNEP FI)

The United Nations Environment Programme – Finance Initiative Principles for Responsible Banking (“UNEP FI Principles”) was created in 2018 to consolidate the

efforts of the UNEP and the financial industry on the enhancement of sustainable finance, having a background from the 1992 Earth Summit (Nwoye, 2019). The framework aligns with the future using the Paris Climate Agreement, the SDGs, and significant sustainable frameworks as its basis to have a positive impact on society. With its six (6) principles, it helps to align the banking system globally with sustainability. The aim is to employ the products, services and relationships the banks keep to help and enhance the basic adjustments of lifestyles and economies' changes and disruptions essential for achieving shared prosperity now and in posterity.

These principles, according to Nwoye (2019), include aligning the banks' strategies with that of the global standards including the SDGs; the Equator Principles; the Paris Climate Agreement; other United Nations parameters, setting impacts and targets to achieve a sustainable business model in their operations and remain effective, inculcating the sustainability aims and target set in their clients and customers' business model to expand the effect of sustainability, incorporating stakeholders at various levels into the achievement of these sustainability goals set and gaining insights on them from the stakeholders, improving the governance and culture of the banks to depict the result aimed at continued relevance and enabling them to be transparently accountable in reporting their outcomes on the set goals.

There are currently two hundred and fourteen (214) signatory members globally on this framework (UNEP Finance Initiative, 2019a). In Nigeria, Access bank Plc. was among the pioneer banks that set this framework up in 2018. A total of ten (10) Nigerian banks including seven (7) listed banks are signatories to this framework. However, two of these banks (FCMB (listed) and Keystone(unlisted)) have been removed as signatories due to their non-compliance as of 2020 (Access Bank Plc, 2020; UNEP Finance Initiative, 2020b) (See Appendix II). The UNEP FI maintains that the financial sector should incorporate sustainability into their financial products, as against treating sustainability as an individual financial product (Weber, 2018).

Global Reporting Initiatives (GRI) Guidelines

This is a universally accepted set of standards for reporting on economic, environmental and social impacts, issued by the Global Sustainability Standards Board (GSSB). The GRI has thirty-six (36) standards in this regard, divided into six codes representing various sectors – GRI 101, GRI 102, GRI 103, GRI 200, GRI 300 and GRI 400. The GRI 300 is the aspect of the principles that relate to the environment and it has sections on materials, energy, emissions, biodiversity, environmental compliance, supplier environmental assessment. Most recently, water and effluents and waste were added to the reporting aspects (GRI, 2020). The GRI principles are not sector-specific and thus do not relate to the banking sector solely, but to every sector that can fit into its reporting standards. However, there are G4 sector-specific disclosures for financial services that preceded the general standards that banks found useful in their global reporting (GRI, 2013; Ozordi et al., 2020).

United Nations Global Compact (UNGC)

The UNGC is a long-standing set of ten (10) principles on sustainability by the United Nations on human rights, labour, environment and anti-corruption. It was adopted in 2005 and subsequently gone through various modifications. The UNGC Principles 7 - 9 are on the environment, as Principle 7 relates to businesses corroborating a preventive approach to environmental issues; Principle 8 on engaging in initiatives to advance grander environmental responsibility; and Principle 9 fostering the improvement and

SDG 13 and Environmental Governance in the Nigerian Financial Sector

circulation of environmentally friendly technologies (United Nations Global Compact, 2020b, 2020a). Among the over 16,000 organisations participating in this compact worldwide, Nigeria has 142 member participants, with eight (8) listed banks included (See Appendix II) (United Nations Global Compact, 2021). The UNGC has a Nigerian network called the Global Compact Nigerian Network (GCNN), it was created in 2006 and currently comprises over a hundred (100) participants from various sectors, including deposit money banks (Access Bank Plc, 2020).

Figure 1. The six UNEP FI principles for responsible banking

Source: (UNEP Finance Initiative, 2019b)

 <p>PRINCIPLE 1: ALIGNMENT</p> <p>We will align our business strategy to be consistent with and contribute to individuals' needs and society's goals, as expressed in the Sustainable Development Goals, the Paris Climate Agreement and relevant national and regional frameworks.</p>	 <p>PRINCIPLE 2: IMPACT & TARGET SETTING</p> <p>We will continuously increase our positive impacts while reducing the negative impacts on, and managing the risks to, people and environment resulting from our activities, products and services. To this end, we will set and publish targets where we can have the most significant impacts.</p>	 <p>PRINCIPLE 3: CLIENTS & CUSTOMERS</p> <p>We will work responsibly with our clients and our customers to encourage sustainable practices and enable economic activities that create shared prosperity for current and future generations.</p>
 <p>PRINCIPLE 4: STAKEHOLDERS</p> <p>We will proactively and responsibly consult, engage and partner with relevant stakeholders to achieve society's goals.</p>	 <p>PRINCIPLE 5: GOVERNANCE & CULTURE</p> <p>We will implement our commitment to these Principles through effective governance and a culture of responsible banking.</p>	 <p>PRINCIPLE 6: TRANSPARENCY & ACCOUNTABILITY</p> <p>We will periodically review our individual and collective implementation of these Principles and be transparent about and accountable for our positive and negative impacts and our contribution to society's goals.</p>

Taskforce on Climate-related Financial Disclosures (TCFD)

TCFD was established in 2015 by the Financial Stability Board (FSB), an international body that supervises and makes recommendations about the global financial system. These disclosures were established to add more value to the financial disclosures on environmental issues as it relates to the core activities of the financial sector and in like manner communicate these risks to the various financial sector stakeholders, aiding more effective decision making on the part of the sector and their stakeholders. The Task Force's recommendations concern insurance companies, banks, asset management companies and asset owners, giving them unique disclosures to concentrate on in order to aid their investment decision on climate-related projects. These disclosures are grouped into four (4) areas – governance, strategy, risk management, and metrics and targets (Demaria & Rigot, 2021; Nisanci, 2021). The TCFD encourages the board of directors to directly supervise climate risks, like financing hazardous projects, activities contributing to harm the environment, etc, that affect the banks. Currently, no Nigerian bank has expressed its support for this initiative (Colas et al., 2020; Nisanci, 2021; Task Force on Climate-related Financial Disclosures, 2021). Oguntuase and Ajibare (2018) encourage Nigerian banks through their apex bank to adapt these disclosures in enhancing climate action consciousness in Nigerian banks.

Sustainable Banking Network (SBN)

This is a knowledge sharing and capacity-building voluntary platform for financial regulators and banking associations in emerging nations formed under the auspices of the International Finance Corporation (IFC). It was founded in 2012 to enhance the drive to sustainable finance with the best international practices among its members. It currently has forty-two (42) nation members, who collectively aim to improve ESG risk management and climate risks' disclosure and amplify capital flows to activities with positive climate impact. Basically, the SBN encourages national initiatives that are specifically tailored to the member country like the Nigerian Sustainable Banking Principles (NSBP) by the CBN (IFC, 2020). The SBN aids the shared learning of its members and helps them in the development of policies and connected initiatives to create a strong force for sustainable finance.

Having considered these climate-related initiatives, it is noteworthy to see that their procedures and principles mostly end with the organisations' reporting on their adherence to the procedures and principles. This duty is that of the board of directors as they are saddled with the responsibility to report on the activities of the organisations they govern to various stakeholders. The sustainability goal is also evident in the frameworks considered in this section, as they all provide requirements for a better society that will aid more economic activities and the liveability of humans. Hence, encouraging banking financiers to be more environmentally courteous in their activities and reporting to stakeholders.

EFFORTS OF NIGERIAN BANKS AND REGULATORS IN TACKLING CLIMATE CHANGE

Nigerian Listed Banks and SDG 13

The banks in Nigeria are geared towards sustainability and thus embrace the global challenge to overcome climate change. There have been various sustainability measures put in place by the banks to reduce the adverse effect their operations have on the environment. From the corporate annual reports considered, these measures range from the decrease in the use of paper during the banks' daily operations to the conversion of power supply in some of their branches and Automated Teller Machines (ATM) outlets to solar energy and/or inverter to reduce the use of fossil fuel. Other measures include the reduction of their employees' use of personal cars through the procurement and use of staff buses to convey them to and from their offices, thus reducing the combustion effect of cars on the environment; switching off power at the close of work; use of energy-saving electrical appliances – lighting, air conditioners; proper waste disposal and recycling initiatives; tree planting in the community; among others. These measures have been given different nametags in order to build a culture of environmental sustainability among the employees. For instance, Access Bank Plc has the 'No Paper Initiative' to reduce the use of paper by using electronic mode of transferring information mainly via e-mail, Stanbic IBTC Plc had the Go-Green Branch Initiative for the same purpose.

A very important move is the issuance of green bond under the auspices of some of the banks and the federal government of Nigeria, to finance environmentally friendly projects in reducing greenhouse gas emissions, among others. According to Weber (2018), green bonds are issued fixed-income bonds to fund projects that are sustainability-related such as sustainable infrastructure, climate mitigation and adaptation, water and renewable energy. Additionally, organisations carry out corporate social responsi-

SDG 13 and Environmental Governance in the Nigerian Financial Sector

bility (CSR) to benefit their communities and aid the sustainability of managing environmental impacts (PWC, 2017; Szennay et al., 2019). The banks also carried out initiatives that relate to climate change in the process of accomplishing their CSR, such as planting trees by Stanbic IBTC and Access Banks, collecting plastics for recycling and utilising the recycling sales to fund charity by Wema Bank, recycling waste to play items for learning institutions by Guaranty Trust Bank, empowering social entrepreneurs with clean cookstoves and biofuel by Access Bank, and so on.

Board of Directors and SDG 13

The 2019 annual reports for the fourteen (14) deposit money banks listed on the Nigerian Stock Exchange (NSE) were considered in this chapter. The objective was to give an analysis of the views of the Board of Directors of Nigerian banks on environmental governance principles. According to Nwoye (2019), the first principle of UNEP-FI on alignment and the fifth principle on governance and culture requires that the governance of banks should give direction to and uphold the stance on sustainability and continued relevance in the business of banking as it revolves from time to time. From the listed banks considered in this chapter, it was observed that none of the banks' board has an Environmental, Social and Governance (ESG) Committee (See Appendix I). The strategic policy formulation and activities review for environmental and social issues in the banks are determined by the governance committee or risk management committee of the various boards. These committees designate the implementation of their strategies to the sustainability committees within the management.

It was further observed that the board of directors of majority of the banks under consideration do not have sufficient knowledge on environmental governance and sustainability issues considering their academic and professional backgrounds which range from banking and finance to management and law. Therefore, the board members will have to undergo special courses aimed at equipping them with adequate knowledge on environmental governance and sustainability. However, from the fourteen listed banks considered, only one of the banks, (See Appendix I) held a refresher course on global sustainability trends for its directors in the course of the year 2019. The general scope of the training of directors for the 2019 financial year considered was on cybersecurity, money laundering and general directorship. There was no focused training on sustainability, climate change or environmental governance, except for only one bank.

On the recognition of the banks' efforts in environmental issues, the Sustainability, Enterprise and Responsibility Awards (SERAs), an initiative of TruContact CSR, that aims to promote and encourage corporate organisations' investments in the society through sustainability projects and corporate social responsibility initiatives (Onwuamaeze, 2020) gave awards to two of the banks for being the best company in environmental excellence and climate action respectively (See Appendix I).

Regulatory Bodies and SDG 13

This section covers the Nigerian banking regulatory bodies' approach to the subject of environmental governance and sustainability. These regulatory bodies are the Central Bank of Nigeria (CBN), Nigerian Deposit Insurance Corporation (NDIC) and the Securities and Exchange Commission (SEC). In recent times, some apex banks and financial regulatory bodies have integrated sustainability into their regulations on risk and its analyses. A report on the effect of climate change on the banking industry in the UK was published by the Bank of England. This report revealed that more supervision is needed

for the financial risks posed by climate change for the banking sector, to reduce the risks faced by the industry to a tolerable level (Weber, 2018). The People's Bank of China integrates environmental indices into its monetary policy structure and assessments of financial stability. Brazil's apex bank made it a requirement for banks to disclose how environmental risks are treated in their determination of capital needs (Bradlow, 2019).

The CBN is a member of the Sustainable Global Network discussed in the second section. According to Park and Kim (2020), the CBN is using a market-making policy through its introduction of the Nigerian Sustainable Banking Principles (NSBP). The NSBP was implemented in 2012 by the Bankers Committee, a committee of the deposit money banks, discount houses, other financial institutions in Nigeria, the Nigerian Deposit Insurance Corporation (NDIC) and the apex bank, Central Bank of Nigeria (CBN). This is a guideline containing nine (9) principles that include environmental and social risk management, environmental and social footprints, human rights, women's economic empowerment, financial inclusion, environmental & social governance, capacity building, collaborative partnerships and reporting (Nigerian Sustainable Banking Principles, 2012). The guideline had a timeline from initiation into the banking system to implementation through to reporting to the regulator. For this chapter, Principles 1 – 3, 6 and 9 (Environmental and Social Risk Management, Environmental and Social Footprint, Environmental & Social (E & S) Governance and Reporting) relate more directly to the concern on the environment.

Principle 6 on Environmental & Social (E & S) Governance required boards of deposit money banks to have a Sustainable Banking Governance committee from the third quarter of 2012. This committee is to supervise the banks' commitment to sustainability issues (issues like the issuance of green bonds, funding green projects, and so on), especially as it relates to environmental and social actions and guarantee that they progress against set objectives and commitments. The principle also suggests an integration of this function to the responsibilities of the risk management committee on the board (Nigerian Sustainable Banking Principles, 2012).

The NDIC in the same vein supports the initiative of the Bankers Committee on sustainable banking. It also has a sustainability desk in the office of its managing director, implements environmental consciousness in its business activities, and increases awareness of sustainability through its financial literacy events and publications (NDIC, 2020). The Securities Exchange Commission (SEC), the regulatory body of the Nigerian Stock Exchange (NSE), has guidelines on sustainability reporting and the issuance of green bonds for companies on the NSE (development in practice, 2019; SEC Nigeria, 2018). These guidelines are being utilised by banks that offer green bonds, like Access Bank's green bond in 2018. The NSE is a participant in the UNGC and a member of the Sustainable Stock Exchanges Initiative (SSE), a UN partnership program involving the United Nations Conference on Trade and Development (UNCTAD), UNGC and UNEP FI, to enhance sustainable investments and reporting on stock exchanges (SSE, 2019).

CONCLUSION AND RECOMMENDATIONS

This chapter has considered the role of the boards of listed Nigerian banks in environmental and sustainability governance. It was discovered that this issue is a high-risk item for which the board must develop good risk management strategies in order to ensure both corporate and environmental sustainability. However, it is also recommended that the board of directors should consider training on environmental issues as this will enhance their outlook on emerging environmental issues more and lead to a better

SDG 13 and Environmental Governance in the Nigerian Financial Sector

living community, and better sustainability reporting. Also, the policy direction of the board of directors in banks should involve designing and launching innovative environmental financing products that will meet the needs of the corporate bank clients, high net worth bank clients and those of the ordinary retail bank clients, to advance environmental sustainability.

It is recommended that the Central Bank of Nigeria (CBN), should consider providing for an Environmental, Social and Governance committee, as a mandatory committee in their Banks' Code of Corporate Governance to be revised in the future. This is in addition to the Sustainability reports being prepared by the banks to showcase their impacts on sustainability initiatives and nation-building. The CBN can also look into joining the Network for Greening the Financial System (NGFS), a network of central banks from all over the world bridging the global gaps and encouraging more attention to climate actions by apex banks. This will aid the advancement of African apex banks on the network. Currently, the Bank of Mauritius, Central Bank of West African States and South African Reserve Bank are the only African apex banks that are members of NGFS.

Corporate entities should be encouraged to do business with banks that adopt global voluntary environmental standards, so as to encourage more Nigerian banks to adopt these standards and to provide the opportunity for collaboration with other international financial organisations thereby increasing their ranking in the international space. This will boost their relations and knowledge media on emerging issues.

As this chapter covered banks listed on the Nigerian Stock Exchange alone, it is suggested that future studies should focus on banks listed on various exchanges in Africa. Also, further research can be undertaken on the other financial institutions and their responses to the Sustainable Development Goals. Furthermore, the efforts of the financial institutions in Nigeria towards climate action in their organisations and as regards financing can be a research focus in the future. It is important to state that this study was not on carbon reporting, as this is a widespread accounting concept being measured by organisations and findings reported, further research can be done on how carbon reporting has enhanced the achievement of the SDG 13 in African countries and the continent as a whole.

In conclusion, this chapter considers the banks' leadership impact, seen through the board of directors and the regulatory bodies, on Climate Action (SDG 13) in Nigerian quoted banks. The findings show the voluntary and mandatory adoption of various guidelines to finance environmentally friendly projects and hence, promote organisational and environmental sustainability. There are a good number of global climatic initiatives that the banks in Nigeria are involved in. This is a great step in the right direction as it helps to maintain the best environmental sustainability practices. There is also due awareness of the culture of environmental safety in the banks and this also affects the manner with which they interact with their customers that are involved in climate or environmentally related projects. This was also considered. Although a number of good efforts have been made by the board of directors and the regulatory bodies in Nigeria, there is still room for more coordinated actions on environmental governance and sustainability.

REFERENCES

Access Bank Plc. (2020). *2019 Annual Report and Accounts*. Author.

Banque de France. (2019). *Greening the Financial System: The New Frontier*. In Banque de France (Ed.), *Banque de France Financial Stability Review* (Vol. 23, Issue June). Banque de France.

- Bradlow, D. (2019, September). Central banks are waking up to climate change dangers. It's about time. *The Conversation*. <https://theconversation.com/central-banks-are-waking-up-to-climate-change-dangers-its-about-time-122204>
- Ceres. (2018). *Ceres*. <https://www.ceres.org/>
- Cho, R. (2019, June). How Climate Change Impacts the Economy. *State of the Planet*. <https://blogs.ei.columbia.edu/2019/06/20/climate-change-economy-impacts/>
- Colas, J., Khaykin, I., & Pyanet, A. (2020, September 21). Climate Change Will Restructure the Economy: Here's How Banks Can Prepare. *Brink News*. <https://www.brinknews.com/how-banks-can-manage-climate-risk/>
- Contreras, G., Bos, J. W. B., & Kleimeier, S. (2019). Self-regulation in sustainable finance: The adoption of the Equator Principles. *World Development*, 122, 306–324. doi:10.1016/j.worlddev.2019.05.030
- Demaria, S., & Rigot, S. (2021). Corporate environmental reporting: Are French firms compliant with the Task Force on Climate Financial Disclosures' recommendations? *Business Strategy and the Environment*, 30(1), 721–738. doi:10.1002/bse.2651
- Development in Practice. (2019, March). Nigeria's new SEC guidelines to boost sustainability reporting. *Development in Practice*. <http://dip.ng/journal/2019/3/17/nigerias-new-sec-guidelines-to-boost-sustainability-reporting>
- Dikau, S., & Volz, U. (2018). *Central Banking, Climate Change and Green Finance* (No. 867). <https://www.adb.org/publications/central-banking-climate-change-and-green->
- Dlugolecki, A., & Loster, T. (2003). Climate Change and the Financial Services Sector: An Appreciation of the UNEPFI Study. *The Geneva Papers on Risk and Insurance. Issues and Practice*, 28(3), 382–393. <https://doi.org/10.1111/1468-0440.00232>
- Elkington, J. (2004). Enter the triple bottom line. In A. Henriques & J. Richardson (Eds.), *The Triple Bottom Line: Does it All Add Up? Assessing the Sustainability of Business and CSR* (Vol. 1). Earthscan. doi:10.4324/9781849773348
- Elkington, J. (2018). 25 years ago I coined the phrase “triple bottom line.” Here's why it's time to rethink it. *Harvard Business Review*. <https://hbr.org/2018/06/25-years-ago-i-coined-the-phrase-triple-bottom-line-heres-why-im-giving-up-on-it>
- EP Association Members & Reporting. (2020). The Equator Principles Association. <https://equator-principles.com/members-reporting/>
- Foundation myclimate. (2020). *What are the effects of climate change?* Myclimate: Shape Our Future. <https://www.myclimate.org/information/faq/faq-detail/what-are-the-effects-of-climate-change/>
- Gössling, S., & Scott, D. (2018). The decarbonisation impasse: Global tourism leaders' views on climate change mitigation. *Journal of Sustainable Tourism*, 26(12), 2071–2086. <https://doi.org/10.1080/09669582.2018.1529770>

SDG 13 and Environmental Governance in the Nigerian Financial Sector

GRI. (2013). *G4 sector-specific disclosures for financial services*. Global Reporting Initiative. <https://www.globalreporting.org/search/?query=G4>

GRI. (2020). *Consolidated Set of GRI Sustainability Reporting Standards 2020*. GRI. <https://www.global-reporting.org/how-to-use-the-gri-standards/resource-center/?g=3a367786-7fee-40e7-824a-53caadc909>

IFC. (2020). *Sustainable Banking Network*. ESG Resources for Companies. https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/company-resources/sustainable-finance/sbn

Isma'il, M., & Kersha, A. J. (2018). Assessment of the Environmental Effects of Flooding in Makurdi Area of Benue State, Nigeria. *Journal of Scientific Research and Reports*, 20(5), 1–11. <https://doi.org/10.9734/jsrr/2018/9848>

Kumar, S., Kumar, N., & Vivekadhish, S. (2016). Millennium Development Goals (MDGs) to Sustainable Development Goals (SDGs): Addressing Unfinished Agenda and Strengthening Sustainable Development and Partnership. *Indian Journal of Community Medicine*, 41(1), 1–4. <https://doi.org/10.4103/0970-0218.170955>

Lubber, M. (2019). 30 Years Later, Investors Still Lead The Way On Sustainability. *Forbes*. <https://www.forbes.com/sites/mindylubber/2019/03/22/30-years-later-investors-still-lead-the-way-on-sustainability/?sh=7ecd051c580c>

Maama, H. (2020). Institutional environment and environmental, social and governance accounting among banks in West Africa. *Meditari Accountancy Research*. doi:10.1108/MEDAR-02-2020-0770

NDIC. (2020). *Frequently Asked Questions*. <https://ndic.gov.ng/frequently-asked-questions/>

Nigeria, S. E. C. (2018). *The Securities And Exchange Commission (SEC) Nigeria Launches Green Bond Rules*. Press Release. <https://sec.gov.ng/the-securities-and-exchange-commision-sec-nigeria-launches-green-bond-rules/>

Nigerian Sustainable Banking Principles. (2012). <https://www.cbn.gov.ng/out/2012/ccd/circular-nsbp.pdf>

Nisanci, D. A. (2021). Case Studies of Climate Risk, Action, and Opportunity. In *World Scientific Encyclopedia of Climate Change* (Issue Volume 3, p. 364). World Scientific. doi:<https://doi.org/10.1142/11526-vol3>

Nwoye, I. S. (2019). *UNEP-FI Principles for Responsible Banking and The CBN Code of Corporate Governance: Improving on the Corporate Governance Discourse in Nigeria*. <https://ssrn.com/abstract=3471431>

Oghojafor, B. E. A., & Aduloju, S. A. (2020). Adoption of Voluntary Global Governance Initiatives: Equator Principles and Banks in Nigeria. *Economics and Organization*, 17(3), 249–260. doi:10.22190/FUEO2004160160

Oguntuase, O. J. (2017). Climate change as financial risk: a survey of bank employees' perception in Nigeria. In G. A. Ajewole & B. Adegbamigbe (Eds.), *Proceedings of Adeniran Ogunsanya College of ...* (pp. 28–36). https://www.researchgate.net/profile/Oluwaseun_Oguntuase/publication/324694786_Climate_change_as_financial_risk_a_survey_of_bank_employees'_perception_in_Nigeria/links/5addbbaeaca272fdaf870917/Climate-change-as-financial-risk-a-survey-of-bank-employees-pe

Oguntuase, O. J., & Ajibare, A. O. (2018). *Leveraging monetary policy and banking regulation for climate action in Nigeria* (No. 89611; Issue 89611). <https://mp.ra.ub.uni-muenchen.de/89611/>

Okonjo-Iweala, N. (2020). *Africa can play a leading role in the fight against climate change*. Brookings: Foresight Africa 2020. <https://www.brookings.edu/research/africa-can-play-a-leading-role-in-the-fight-against-climate-change/#footnote-10>

Onwuamaeze, D. (2020, December 15). SERAS Awards: Zenith Bank Boss, Onyeagwu, Emerges CEO of the Year. *ThisDay*. <https://www.thisdaylive.com/index.php/2020/12/15/seras-awards-zenith-bank-boss-onyeagwu-emerges-ceo-of-the-year/>

Oserogho, I. F. A. (2020). Extent of Environmental Disclosure of Listed Non-Financial Firms in Nigeria: Does Board Characteristics Matter? *Ilorin Journal of Human Resource Management*, 4(1), 215–226.

Oteh, A., & Sanni, T. F. (2021). *Africa Investment Roundtable - Sustainability En route to COP26*. Youtube. <https://www.youtube.com/watch?v=IpxDSrHkKU>

Ozordi, E., Eluyela, D. F., Uwuigbe, U., Uwuigbe, O. R., & Nwaze, C. E. (2020). Gender diversity and sustainability responsiveness: Evidence from Nigerian fixed money deposit banks. *Problems and Perspectives in Management*, 18(1), 119–129. [https://doi.org/10.21511/ppm.18\(1\).2020.11](https://doi.org/10.21511/ppm.18(1).2020.11)

Park, H., & Kim, J. D. (2020). Transition towards green banking: Role of financial regulators and financial institutions. *Asian Journal of Sustainability and Social Responsibility*, 5(1). <https://doi.org/10.1186/s41180-020-00034-3>

Petersen, H. L. (2013). Coalition of Environmentally Responsible Economies (CERES). In S. O. Idowu, N. Capaldi, L. Zu, & A. Das Gupta (Eds.), *Encyclopedia of Corporate Social Responsibility* (pp. 365–367). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-28036-8_467.

PWC. (2017). *SDG Reporting Challenge 2017: Exploring business communication on the global goals*. <https://www.pwc.com/sdgreportingchallenge>

Srinivas, H. (2020). *The Coalition for Environmentally Responsible Economies (CERES) Principles. Sustainable and Green Businesses: Documents and Reports*. <https://www.gdrc.org/sustbiz/ceres-principles.html>

SSE. (2019). *Nigerian Stock Exchange*. Sustainable Stock Exchanges Initiative. https://sseinitiative.org/stock-exchange/nse_nigeria/

Szennay, Á., Szigeti, C., Kovács, N., & Szabó, D. R. (2019). Through the Blurry Looking Glass—SDGs in the GRI Reports. *Resources*, 8(101), 1–17. <https://doi.org/10.3390/resources8020101>

Task Force on Climate-related Financial Disclosures. (2021). *Task Force on Climate-related Financial Disclosures*. TCFD. <https://www.fsb-tcf.d.org/>

The Equator Principles. (2020). www.equator-principles.com

UN Office for the Coordination of Humanitarian Affairs (OCHA). (2021). *Southern Africa – Tropical Cyclone Eloise Flash Update No.9, As of 26 January 2021*. Reliefweb. <https://reliefweb.int/report/mozambique/southern-africa-tropical-cyclone-eloise-flash-update-no9-26-january-2021>

SDG 13 and Environmental Governance in the Nigerian Financial Sector

UNEP Finance Initiative. (2017). *The Principles for Positive Impact Finance*. <https://www.unepfi.org/wordpress/wp-content/uploads/2017/01/POSITIVE-IMPACT-PRINCIPLES-AW-WEB.pdf>

UNEP Finance Initiative. (2019a). *Principles for Responsible Banking*. <https://www.unepfi.org/wordpress/wp-content/uploads/2019/07/FINAL-PRB-Signature-Document-2-Interactive-22-07-19.pdf>

UNEP Finance Initiative. (2019b). *The Principles for Responsible Banking*. <https://www.unepfi.org/wordpress/wp-content/uploads/2019/09/Principles-Horizontal.png>

UNEP Finance Initiative. (2020a). *Africa & Middle East Members*. <https://www.unepfi.org/members/africa-middle-east/>

UNEP Finance Initiative. (2020b). *Signatories to the Principles for Responsible Banking*. https://www.unepfi.org/wordpress/wp-content/uploads/2021/02/PRB_Signatories_0802-2.pdf

United Nations. (2015). *Transforming our world: the 2030 agenda for sustainable development*.

United Nations Global Compact. (2020a). *Our Governance*. UN Global Compact Office. <https://www.unglobalcompact.org/about/governance>

United Nations Global Compact. (2020b). *The Ten Principles of the UN Global Compact*. UN Global Compact Office. <https://www.unglobalcompact.org/what-is-gc/mission/principles>

United Nations Global Compact. (2021). *Our Participants*. UN Global Compact Office. https://www.unglobalcompact.org/what-is-gc/participants/search?page=12&search%5Bcountries%5D%5B%5D=145&search%5Bkeywords%5D=&search%5Bper_page%5D=10&search%5Bsort_direction%5D=asc&search%5Bsort_field%5D=&utf8=✓

Weber, O. (2018). The Financial Sector and the SDGs: Interconnections and Future Directions. *Centre for International Governance Innovation, 201*, 1–32. www.cigionline.org

Weber, O., & Feltmate, B. (2016). *Sustainable Banking: Managing the Social and Environmental Impact of Financial Institutions*. University of Toronto Press. <https://utorontopress.com/us/sustainable-banking-4>

Zhang, Y., Lim, S., & Sharples, J. J. (2017). Wildfire occurrence patterns in ecoregions of New South Wales and Australian Capital Territory, Australia. *Natural Hazards, 87*(1), 415–435. doi:10.1007/11069-017-2770-1

Zhang, Y., Wang, Q., Wang, Z., Yang, Y., & Li, J. (2020). Impact of human activities and climate change on the grassland dynamics under different regime policies in the Mongolian Plateau. *Science of the Total Environment, 698*, 1–10. doi:10.1016/j.scitotenv.2019.134304

ADDITIONAL READING

FC4S. (2018). *Building Shared Language for Green and Sustainable Finance — Guiding Principles for the Development of Taxonomies*. https://docs.wixstatic.com/ugd/eb1f0b_91e9978f38504f61a9d92c484f378a08.pdf

Floyd, D. (2017). *Social Impact Bonds: An Overview of the Global Market for Commissioners and Policymakers*. http://socialspider.com/wp-content/uploads/2017/04/SS_SocialImpactReport_4.0.pdf

Griggs, D., Stafford-Smith, M., Gaffney, O., Rockström, J., Öhman, M. C., Shyamsundar, P., Steffan, W., Glaser, G., & Noble, I. (2013). Policy: Sustainable development goals for people and planet. *Nature*, 495(7441), 305–307. doi:10.1038/495305a PMID:23518546

Khovrenkov, I., & Kobayashi, C. (2018). *Assessing Social Impact Bonds in Canada*. www.schoolofpublicpolicy.sk.ca/research/publications/policy-brief/Assessingsocial-impact-bonds-in-Canada.php

Niculescu, M. (2017). *Impact investment to close the SDG funding gap*. Our Perspectives (blog). www.undp.org/content/undp/en/home/blog/2017/7/13/What-kind-of-blenderdo-we-need-to-finance-the-SDGs-.html

Trotta, A., Caré, R., Severino, R., Migliazza, M. C., & Rizzello, A. (2015). Mobilizing Private Finance for Public Good: Challenges and Opportunities of Social Impact Bonds. *European Scientific Journal*, 11(10), 259–279.

Weber, O., & Blair, F. (2016). *Sustainable Banking: Managing the Social and Environmental Impact of Financial Institutions*. University of Toronto Press. doi:10.3138/9781442629325

Weber, O., Hoque, A., & Islam, M. A. (2015). Incorporating environmental criteria into credit risk management in Bangladeshi banks. *Journal of Sustainable Finance & Investment*, 5(1-2), 1–15. doi:10.1080/20430795.2015.1008736

Wiek, A., & Weber, O. (2014). Sustainability challenges and the ambivalent role of the financial sector. *Journal of Sustainable Finance & Investment*, 4(1), 9–20. doi:10.1080/20430795.2014.887349

Yuan, F., & Gallagher, K. P. (2015). *Greening Development Finance in the Americas*. Boston University Global Economic Governance Initiative.

KEY TERMS AND DEFINITIONS

Board of Directors: These are the members of the board saddled with the responsibility of deciding the strategic direction of an organisation and making policies towards it.

Deposit Money Banks: Also referred to as banks in this chapter, are financial organisations that carry out the functions of funds safety, loan administration, financial advisory, among others.

Environmental Governance: This is the leadership and strategy decisions on environmental issues.

Environmental, Social, and Governance (ESG) Committee: A committee on the board of directors that is basically involved in environmental and social matters.

Regulatory Bodies: They are government agencies saddled with the tasks to supervise the activities of the groups they represent.

APPENDIX 1

Table 2. Listed banks on the Nigerian Stock Exchange (NSE)

	Bank	Total Directors	ESG Committee	Training	Environmental Awards
1	Access	17	Nil	Nil	Best Company in Climate Action
2	Ecobank	13	Nil	Nil	
3	FCMB	11	Nil	Nil	
4	Fidelity	14	Nil	Nil	
5	First Bank	14	Nil	Nil	
6	GTB	14	Nil	Nil	
7	Jaiz	15	Nil	Nil	
8	Stanbic IBTC	10	Nil	Nil	
9	Sterling	14	Nil	Nil	
10	UBA	20	Nil	Nil	
11	Union	13	Nil	Nil	Best Company in Environmental Excellence
12	Unity	9	Nil	Nil	
13	Wema	11	Nil	1 - refresher course on global sustainability trends	
14	Zenith	13	Nil	Nil	

Source: Authors' compilation

APPENDIX 2

Table 3. Global Frameworks and Member Banks

	Bank	EP	UNEP FI	GRI	UNGC	TCFD	GSBP
	Listed						
1	Access	√	√	√	√	-	√
2	Ecobank	√	-	-	√	-	√/#
3	FCMB	-	-*	-	√	-	-
4	Fidelity	√	-	-	√	-	-
5	First Bank	-	-	√	√	-	-
6	GTB	-	-	√	-	-	-
7	Jaiz	-	√	√	-	-	√
8	Stanbic IBTC	√	√	-	-	-	√/#
9	Sterling	-	-	-	√	-	-
10	UBA	√	-	-	-	-	-
11	Union	-	-	-	√	-	-
12	Unity	-	-	-	-	-	-
13	Wema	-	√	-	-	-	√
14	Zenith	-	√	-	√	-	√

Source: Authors' Compilation

Key	
√	Member
-	Non-member
√/#	Group member
-*	Removed in 2020 for noncompliance
EP	Equator Principle
UNEP FI	United Nations Environmental Principles for Financial Institutions
PRB	Principles for Responsible Banking
GRI	Global Reporting Index
UNGC	United Nations Global Compact
TCFD	Taskforce on Climate-related Financial Disclosures
GSBP	Global Sustainability Banking Principles

Chapter 5


Nexus of Climate Change and Sustainable Real Estate

Thabiso Sthembiso Msomi

 <https://orcid.org/0000-0002-8500-2624>

Durban University of Technology, South Africa

Odunayo Magret Olarewaju

 <https://orcid.org/0000-0002-4366-040X>

Durban University of Technology, South Africa

ABSTRACT

This chapter investigates the nexus of climate change and real estate sustainability. Climate change is the topical dramatic swing of the planet's normal climate patterns caused by a spike in emissions of carbon dioxide triggered by human activities. Climate change risk is not being effectively estimated into commercial real estate assessments. Due to high demand for coastal properties, a lopsided share of commercial real estate is vulnerable to climate change risks. Thus, it was concluded that real estate is an essential part of an evolving growth phenomenon and also plays a major role in stimulating economic growth. This makes it important for investors and property owners/dealers to be resilient in combating climate change, and adequate information should be available for investors so they will know the risk attached to their investment.

BACKGROUND TO THE STUDY

In recent years, real estate and construction have begun to make a concerted effort not just to counteract the climate change effect of the industry, but to efficiently and effectively build solutions (Teicher, 2018). Property, land, buildings, air rights above the land, and underground rights below the land are all examples of real estate. The industry's new determination to lessen its effect is a decidedly optimistic and significant step in the climate change reduction campaign, either due to anticipated tighter legislation, public pressure, or generational shift (Warren-Myers, Hurlimann & Bush, 2020). For some time, the impetus for sustainable change within the real estate sector has been emerging, setting the stage

DOI: 10.4018/978-1-7998-7967-1.ch005

for the development of both technological capabilities and market preference. The poor effort of the environmental movement from the construction sector and real estate has led, from carbon emissions to resource use and land growth, to an overwhelmingly hostile picture of the industry (Francart, Larsson, Malmqvist, Erlandsson & Florell, 2019). For real estate owners and developers, being submerged has often been a metaphorical shorthand for problematic periods when land debt exceeds property value or spending exceeds profits (Giglio, Maggiori, Stroebel & Weber, 2015). The term has a new meaning now, however, as real estate may be threatened by potential climate change. Rising ocean and land temperatures, extreme south and north latitudes, weather trends and unprecedented frequency and severity of weather-related events such as wildfires, floods, and hurricanes, accelerated glacial melting at the poles, shifting biosphere patterns, increasing sea level is detectable and measurable. Humans may not have to be scientists to acknowledge that real estate may be disproportionately influenced by the market and physical impacts of climate change.

At all geographical locations and scales, threats exist along seacoasts, within watersheds, on hillsides, and in fragile urban, exurban, and suburban areas (Teicher, 2018). Individual buildings are also in danger, depending on their design and location. For ages, non-governmental organisations (NGOs) and alerts from scientists have repeatedly censored the field. New reporting requirements were implemented by regulations and their objections were raised by consumers, millennials, even investors. But the strain has only begun to make a change in the previous year or so, and only by recognising the full magnitude of the danger posed by climate change to real estate assets has it been strengthened. In 2019, retail spaces and offices were predicted to be vulnerable to flooding and sea-level rise by publishers and market intelligence providers on the economic danger of climate change (Locatelli, Guerrero, Russo, Martínez-Gomariz, Sunyer & Martínez, 2020). It is time for the building and real estate industries to consider initiating real action against climate change (Giglio et al., 2015). In their plans, investors are now taking into account climate change by investing directly in unique asset mitigation measures, participating in local resilience strategies, incorporating climate risk in their due diligence processes, mapping physical threats for existing portfolios and future acquisitions, and integrating physical adaptation and threat asset mitigation measures (Teicher, 2018).

STATEMENT OF THE PROBLEM

It is well documented and scientifically proven that climate change impacts real estate in a variety of respects. There is clear scientific evidence that the burning of fossil fuels causes carbon emissions that change the atmosphere (Bunten & Kahn, 2017). The consequences of climate change include a rise in extreme weather events and changes in the availability of natural resources, with a direct influence on the real estate industry (Muldoon-Smith & Greenhalgh, 2019). Since value creation and preservation is a key concept of the real estate industry, climate risks need to be identified and measured so that they can be handled and controlled to prevent adverse impacts on value (Wieteska-Rosiak, 2020). The assessment of opportunity against risk is critical for any investor, and real estate investors in particular, in the age of climate change, the risk is increasing exponentially. Progressive climate change could negatively affect the growth and viability of the real estate market as well as property values (Teicher, 2018). Ownership costs and investment, including taxation, code compliance, insurance, infrastructure, and finances, may be increased by policymakers to reduce climate change impacts (Bunten and Kahn, 2017).

Notwithstanding the intensification stated above, little attention seems to be paid to this field of research in the real estate sector, particularly in the sense of climate change, thus creating a research gap. The goal of the research is to provide a broad understanding of the type of issue at hand in developing and developed countries. Given that limited studies have been undertaken on the same subject on the African continent, it will contribute to the subject as a new understanding of climate change on the sustainability of real estate around the world. In addition to the findings of this study, it will be important to strengthen understanding of the basic sustainability of the real estate sector during climate changes. The purpose of this chapter would then be to bridge the gap described above by providing more information on the effects of climate change on the sustainability of real estate in the different continents. Finally, the results will offer insight into the effect of climate change on the sustainability of real estate and help real estate to improve their sustainability to be able to be resilient towards climate change.

FACTORING CLIMATE CHANGE INTO REAL ESTATE INVESTMENT

Physical threats are those specifically triggered by particular catastrophic events, hurricanes, rising sea level, drought, wildfires, ultimately due to climate change and changing patterns of weather. The cost of preserving, restoring, and reconstructing badly damaged or demolished buildings, increasing property insurance rates, and economic efficiency losses are among the many adverse repercussions of such events (Christophers, 2019). Transition threats over time that are not due to single catastrophic incidents are less evident. Progressive climate change could depress the financial stability of the real estate market, as well as property values.

The ULI-Heitman (2019) study explicitly cites instability in the insurance sector arising from speculation about an undefinable future and possibly rapidly rising premiums expected to cover ever-larger damages and claims. Viable and effective insurance, a cornerstone to risk management, relies on becoming capable of recognizing potential risks and quantifying them fairly. The task, as the report states, is to find out how to quantify and mitigate potential risks of climate change affecting land preservation and physical stability, as well as property value, revenue, liquidity, and capital appreciation (Warren-Myers, Hurlimann & Bush, 2020). Specialists in the real estate industry are starting to resolve this by analytically mapping particular physical hazards associated with assets they own. Mapping combines site-specific current and historical data with predictive geophysical, economic, and meteorological modeling (Bunten & Kahn, 2017).

EFFECT OF SEA LEVEL RISE ON CLIMATE CHANGE

Climate change is predicted to have a substantial effect on the environment and human activities at high latitudes due to the increased greenhouse effect (Nerem, Beckley, Fasullo, Hamlington, Masters & Mitchum, 2018). It should have a positive impact on human behaviour, for the most part. Global warming is projected to become more extreme over the next centuries due to rising greenhouse gas emissions (Vu, Yamada & Ishidaira, 2018). Such warming will have a great effect on both natural and human activities. In particular, climate change has a strong influence across the whole of society at high latitudes (Nerem et al., 2018), for example, higher temperatures would decrease energy requirements for heating, and a lengthening of the growing season would benefit agricultural production. Sea-level rise has become

one of the key issues that must be taken into account in determining the effects of climate change. It will cause sandy beaches to erode, coastal areas to flood, and harbour buildings to be demolished. The increase in sea level due to the thermal expansion and melting of glaciers, ice caps, and ice sheets is a topical concern on both a global and national level (Raymo, 2015).

One of the most important impacts of climate change is the increase in sea levels (Lindsey, 2018). Strongly predicted rates of potential sea-level rise have drawn global attention (Cazenave & Cozannet, 2014). In particular, low-lying and small island countries are worried that their land areas will be diminished due to floods and coastal erosion and, at the very worst, a significant proportion of their population will be compelled to move to other countries (McMichael et al., 2020). This topic has also resulted in increased global importance, as the implications of climate change are becoming evident. Owing to physical phenomena such as tides and waves, the depth of the sea changes with time and space (Nerem, Beckley, Fasullo, Hamlington, Masters & Mitchum, 2018). The mean sea level at a given location is defined as the average sea surface height over a specific duration, such as a month or a year, long enough to largely eliminate fluctuations caused by tides and waves. The mean sea level in the world is often spatially distributed. The average water level in the world's oceans is considered the global mean sea level (GMSL). Local mean sea level changes typically vary from GMSL, as regional and local-scale dominant phenomena alter the global mean change.

CLIMATE CHANGE AND HOME OWNERSHIP

The earth's global temperature has risen by 1 degree Celsius since the late 1800s (or 1.8 degrees Fahrenheit). Studies have indicated that if we continue the very same emissions trajectory, the global temperature will rise by 1.5 degrees Celsius by 2040 as well as 2 degrees Celsius by 2100 (Kogan, Guo & Yang, 2020). Those rises may not appear dramatic on the surface. Scientists emphasise, however, that even half a degree will have catastrophic implications for the world (Busby, 2018). A half-degree temperature rise in the Arctic will make "ice-free summers" 10 times more possible (from 1.5 degrees Celsius to 2 degrees Celsius). A half-degree rise worldwide will expose 37 percent of the world's population once every five years to extreme weather (Sam-Aggrey & Lanteigne, 2020). Coral reefs would largely vanish in the seas, and 32 to 80 million people would be vulnerable to rising sea levels (Kulp & Strauss, 2019). As a result of greenhouse emissions and the burning of fossil fuels, the National Aeronautics and Space Administration (NASA) describes global warming as a gradual rise in the earth's average surface temperature over the previous century. Most scientists agree on the basic aspects of climate change exacerbated by humans (Kogan, Guo & Yang, 2020; Sam-Aggrey & Lanteigne, 2020).

CLIMATE CHANGE AND MARKET VALUE OF REAL ESTATE

In order to shape an opinion on market value, property valuers often look at past customer transactions (Baldauf, Garlappi & Yannelis, 2020). Evaluating climate change relies on predictions of what might happen in the future, whether in the short or long term. In order to have the necessary prophetic insight, property valuers should therefore not depend on past market actions in relation to climate change (Keenan, Hill & Gumber, 2018). Climate change is a reality with large social, environmental, and economic ramifications (Nordhaus, 2019). Due to the projected temperature rise of 4 to 6.4 degrees Celsius by

2099, there will be a notable trend in shifting weather and precipitation and a sea-level increase of 0.59 meters (Change, 2007; Salman, Shahid, Ismail, Ahmed & Wang, 2018). Assessing risk opportunities is important for any investor. In the age of climate change, the risk is exponentially growing for real estate investors in particular. Big property companies use large quantities of capital, to quantify climate risk, ranging from growing extreme weather to an increase in sea levels, and its possible effects on real estate (Keenan, Hill & Gumber, 2018). There is a major danger of both residential and industrial buildings to climate threats such as hurricanes or wildfires (Dixon, Bullock & Adams, 2019). Apart from property damage, climate events may lead to more than a decrease in the value of the property or higher insurance rates (Dalhaus, Musshoff & Finger, 2018). They can also be costly to maintain and run. A natural disaster may cause total loss of property in the worst-case scenario. Given the substantial implications that climate risks have, the evaluation of investment risk against opportunities fails to standardize (Dixon, Bullock & Adams, 2019).

In a research study by Heberger, Kirsch, Donhauser, Nissle, Gurka, Schmeer, and Aurich (2016), the replacement value of the property was used to assess the economic effects of sea-level rise. They recognized the difference between replacement costs and market value and indicated that market rates are higher because of a variety of site-specific factors, while replacement value focuses on national average construction costs because of a variety of site-specific factors. Their analysis was limited, according to the authors, by the limitations associated with the methodology of economic valuation (Heberger et al., 2016).

In order to quantify the economic cost of sea-level rise, King, Butler, Jucker, Earl, and Rudeva (2019) used the measured value. The authors pointed out that age function data, but also the nature and condition of assets, were not widely available and that flood and erosion risk properties were therefore priced using a consistent depreciation factor of 25 percent (King et al., 2019). They also suggested that depreciated replacement values are sufficient for the estimation of structural damages, but that the market value of land (which actually falls into the ocean and cannot be replaced) is more appropriate for the estimation of land damage associated with upland erosion (King et al., 2019). The argument that the sales comparison approach is the ideal method to be used when there are small market sales but usable data documenting various site features for all properties indicates that the writers of this paper are not at all familiar with the property valuation methodology, because the sales comparison approach relies on sales data to assess market value (King et al., 2019).

“As the market value of a property is expressed in its land value, the land value could be used to determine the fair value and, therefore, vulnerability”, it is suggested in an Australian study (Hennecke et al., 2019). Even though the authors described market value as land value plus the value of improvement, they seemed to neglect the value of improvement and focus solely on land value to illustrate market value (Hennecke et al., 2019).

SUSTAINABLE REAL ESTATE INVESTMENT

Sustainable investment is more about the real estate industry’s obligation and capacity to meet environmental and climate sustainability goals (Kauškale & Geipele, 2017). The real estate industry forms an integral part of an unparalleled level of development and operation in a highly urbanised world (Jackson, 2009). In order to achieve a reduction in greenhouse gas emissions in the form of real estate development and operations, developers, occupiers, cities and governments can and must play an important role

(Geiger, Cajias & Bienert, 2013). From the Environmental Sustainability Principles for the Real Estate Industry Report, the World Economic Forum reports that the real estate sector absorbs more than 40 percent of global energy each year, that buildings produce 20 percent of global greenhouse gas emissions and that they use 40 percent, respectively, of raw materials. Climate change is a significant issue related to environmental sustainability (Owusu & Asumadu-Sarkodie, 2016), and 195 countries have adopted the first-ever agreement at COP21, the Paris climate conference in December 2015, which sets a goal for mitigating the adverse impacts of climate change by restricting global warming to far below the 2-degree Celsius mark (Rhodes, 2016).

In order to remain below the 2-degree Celsius threshold, the World Bank estimates that the real estate sector would reduce carbon dioxide emissions by 36 percent by 2030 (Zhou, Price, Yande, Creyts, Khanna, Fridley & Franconi, 2019). If the world's nations do not rapidly prevent global warming, in the upcoming years, temperatures will increase dramatically (Williamson, Satre-Meloy, Velasco & Green, 2018). Disastrous consequences are likely to include food and freshwater shortages, the proliferation of diseases as well as rising sea levels, which would flood coastal towns and submerge many island nations (Sun, Miao, Hanel, Borthwick, Duan, Ji & Li, 2019). The International Panel on Climate Change (IPCC) of the United Nations reports that an average increase of 1.5 degrees Celsius would put 20 to 30 percent of species at risk of extinction (Begum & Momen, 2021). Furthermore, growing severe weather events such as floods and storms are likely to have a significant effect on economies as well as investment performance in the property industry and infrastructure. Governments and communities will continue to develop and implement sustainable and comprehensive long-term strategies that enable investors in real estate to cooperate and fund such initiatives (Mees, Uittenbroek, Hegger & Driessen, 2019). This ensures that the real estate market will continue to be a prime focus for policy action. This presents the real estate industry with fresh challenges and opportunities with significant consequences for both owners and occupiers.

Over the previous decade, sustainable real estate investments have grown from a niche concern to a common commodity for new real estate projects and investment goods (Christensen, 2017). Green buildings account for a large share of global construction projects, which are projected to expand further. If investors invest in new construction ventures, they have a sustainability ranking or are eligible to do so. In order to accomplish the reduction of carbon dioxide emissions required for future generations to protect the environment, we need to carry out sustainability-oriented retrofits and renovations of existing buildings (Begum & Momen, 2021). This process is bound to be burdensome in the short term; some sustainability-driven features pay for themselves, while others do not pay for themselves at this time, but it is also a fair and cost-effective way of achieving the necessary carbon dioxide emission reductions.

CLIMATE CHANGE AND PROPERTY VALUES

The evolving nature of climate change and climate change-related events poses the issue of how and to how the changing climate impacts the property appraisal processes (Gibson, Mullins & Hill, 2017). The following influences on the property market can be classified: influences on the carbon trade, green building preferences, and issues at the sea level.

Carbon Trading Impacts: The implementation of carbon property includes the establishment of long-term carbon property rights. In turn, these depend on the capacity of the community to define, measure and manage carbon content in real estate. Hepburn (2005) explained how carbon, typically as

an ownership right within the forestry domain, has been defined by different states. John Sheehan (2007) has explained in detail some of the difficulties in developing effective carbon property, notwithstanding the implementation of carbon trading. The detachment of carbon property from the land would have certain consequences close to the separation of water assets, in that the value of the components of the different elements would decrease the value of the land assets left behind. This could have contingent changes in land taxes, transfer duties, and the valuation of debt protection. It can also establish the possibility of long-term land utilisation restrictions. The flexibility of carbon property transfer can also lead to speculative bubbles and difficulty concentrating. Besides the complexities and costs related to the development and differentiation of rights, the net value of the resulting package of individual property rights should not be substantially different from that of simple basic property rights, although market inefficiencies could undermine this outcome.

Green Building Preferences: For some time, involvement in building forms that reduce energy use and thus carbon emissions have grown, leading to different systems of so-called environmental efficiency primarily related to the effects of carbon emissions (Zuo & Zhao, 2014). In attempting to classify the value influences of so-called green construction, significant interest has been evident (Ulubeyli & Kazanci, 2018). Reasonable green building benefits should be related to decreased energy costs and should also provide contingent benefits, including health benefits for residents, contributing to lower costs of sick leave. The available research was analyzed and expanded by Norm Miller and others (Miller, Spivey, et al., 2008) and established that green buildings have a marginal net profit, but their research centered on rents and prices alone. They acknowledged, more significantly, the omnipresent role of state incentives in promoting a strong marketplace. US government tenants, including Australia, are pressured by the policy to settle for green buildings that produce a politically rooted bias in the green building rental market (Self, 2021). Similarly, there are a number of material incentives to build and own green investment assets from different levels of government. Both policies aim to boost the return to green buildings, but natural economic advantages can hardly be considered. Despite expressing a tendency for non-green buildings to bear a discount, private tenants do not show a preference for green buildings. In Australia, David Parker (2008) represents researchers who have determined that green building design has a marginal direct value effect, with value differences best understood by indirect effects. This is due to the political desire of government tenants for green buildings, anxiety about potential future regulatory discrimination against non-green buildings, and a growing number of private tenants who would like to project an image that is environmentally friendly.

Under this model, the effects of green buildings on value come more from fear of reprisal or potential changes of preference than from direct quantifiable commercial benefits (Self, 2021). Much of the secondary value effect dynamic depends on the ongoing public perception that the use of human carbon-based resources is environmentally problematic. That is, artificial political pressures and unproven potential risks are best compensated for by value differences where they occur than by any innate present advantage or direct incentive to select buildings classified as green (Zuo & Zhao, 2014).

Sea Level Concerns: The consequences of sea-level rise have been discussed by several government bodies (Abia, Onya, Shum, Amba, Niba & Abia, 2020). Some governments, like Auckland, New Zealand, have acknowledged the possible legal risk of allowing construction to continue in areas that could be flooded because of the increase in sea level. Direct sea level rises and hypothesised rises in tidal extremes and storm surges are the threats of greenhouse-induced climate change problems in low-lying regions (Murfin & Spiegel, 2020). At present, the extent of sea-level rise is highly conjectural, but sober forecasts position that over the next century no more than a maximum of 88cm. It should be recalled

that a century is far beyond the normal economic life of current innovations in buildings (McAlpine & Porter, 2018). There seems to be hypocrisy in attitudes to sea level rise at present. On the one hand, severe sea level rise forecasts tend to have a substantial following. On the other hand, there does not seem to be any published research showing the full creation of a consumer preference for higher-level land (Fu, Song, Sun & Peng, 2016). Owing to fears about a future invasion, this could be contrasted with the early post-war stigma associated with waterfront land. In the latter case, for several years after the war, waterfront housing held a negative connotation.

A highly debatable theory that currently gets a high degree of public support despite the lack of clear empirical support is anthropogenic global warming (AGW) (Fu, Song, Sun & Peng, 2016). It started during the latter decades of the century as a rational subject for publicity, but changes over the last decade are revealing evidence that makes the hypothesis seem quite unlikely to be true. Given this, in the next decade, carbon property trading has begun and will accelerate in value. If the costs of establishing a carbon property regime and the contingent issues of AGW prove to be a baseless concern, it would generate unjustified appearances (Ryghaug, Holtan Sørensen & Næss, 2011). The repercussions of efficient buildings with carbon emissions do not seem to be of direct commercial merit. Their only appeal is due to political views and these may result in building requirements for occupying compliant buildings. It is obvious from this that any value gain from green buildings will seem to be the product of political factors rather than economic ones. As the poor relation between energy-efficient construction and global temperature regulation is recognised, the political aspect is further evident (Sadineni, Madala & Boehm, 2011).

Sea level rise for the low-level property should be a concern (Abia, Onya, Shum, Amba, Niba & Abia, 2020). While development consent authorities are obsessed with permitting construction in areas that could be flooded in the future, there appears to be no indication of a move away from the lower coastal land by the community (Murfin & Spiegel, 2020). The slow approach of any flood crisis, which may be over the duration of many construction lives, makes the hostility of the public reasonable. The topic of climate change does draw strong political support, despite the lack of direct scientific support for the AGW hypothesis. The political effects of the hypothesis seem to be much more likely to continue exercising the dominant power over the real impacts on land. Therefore, in order to deduce the relevance of the carbon pollution problem for property in the future, attention has been focused on the course of public opinion and political activism.

CLIMATE CHANGE ON COMMERCIAL REAL ESTATE

Commercial real estate assets are owned over the course of decades, with the expectation of steady revenue and value increases (Westcott, Ward, Surminski, Sayers, Bresch & Claire, 2020). In areas where governments are stable, the rule of law prevails, the economy is growing and the infrastructure is well funded and maintained, wise owners are investing. However, a wise investor also needs to assess the environmental resilience of investment locations, particularly in light of climate change, which threatens to alter the stability of global environmental conditions (Westcott, Ward, Surminski, Sayers, Bresch & Claire, 2020). Risk portfolios are exposed on an absolute basis and compared to other institutional investors in order to consider and evaluate them; global real estate advisors have developed an analytical framework to help evaluate the devastating risks associated with climate change (Westcott, Ward, Surminski, Sayers, Bresch & Claire, 2020). In addition, advisors assessed the climate resilience of individual

markets particularly in Miami and South Florida, where it is believed that the oversized risk of climate change should deter institutional investment. A risk analysis tool is an analytical tool that helps measure the risks involved with investments and compare this risk against an institutional investment portfolio model. The findings track the threats associated with freshwater floods, hurricanes, and tornadoes. While these risks are uncommon and can often be protected against, this benchmark analysis makes it easier to understand how the portfolio is today and enables the assessment of changes over time as climate change progresses and drives changes in insurance markets. While property insurance at first appears to be one of the strongest protections against environmental threats such as climate change, the market is designed to provide short-term protection against long-term risks. Since the owner of the property has been saving for decades, his insurance plans are likely to be active for just one year, whereas insurance caps are likely to cover accidents that occur every few hundred years. Although this temporary disconnection is acceptable as long as the underlying risk does not change from year to year, the cost of insurance and the value of the property can change significantly, as with climate change. In order to make informed investment decisions in areas affected by these changing risks, it is important to understand how climate change could impact the affected insurance and property markets, especially the risk of hurricanes and coastal flooding where the model portfolio shows the most exposure.

CONCLUSION AND RECOMMENDATIONS

Real estate as an essential part of an emerging growth phenomenon also plays a major role in stimulating economic growth. While growth moderates in many emerging markets, the pace of construction continues to rise rapidly. However, change is just part of the story. The growth of emerging economies is also raising the competitiveness between real estate managers and the investment community. For real estate investors, climate change risks are accompanied by natural disasters, not only property damage but complete destruction. Thus, the following are recommended:

1. Climate change is to be factored into the real estate market, providing further data and information which will enable real estate agents and investors (prospective investors inclusive) to make more up-to-date decisions when it comes to acquiring property. Investors will also be able to know the risk that comes with their investment.
2. Financial institutions should put in place strategies on climate change risks and should be filtered through to the real estate market.
3. Those in the real estate industry should work together to generate industry-wide standards that anticipate and measure climate risks in their property valuations and decision-making.
4. There should be an integrated industry-wide response and united education and awareness which will increase resilience to the risk posed by climate change.
5. Proper underwriting for properties in areas that are most susceptible to climate change is required.
6. Insurance should be substantiated enough to mitigate the risks posed by extreme weather events on properties.

REFERENCES

- Abia, W. A., Onya, C. A., Shum, C. E., Amba, W. E., Niba, K. L., & Abia, E. A. (2020). Food Security Concerns, Climate Change and Sea Level Rise in Coastal Cameroon. *African Handbook of Climate Change Adaptation*, 1-13.
- Baldauf, M., Garlappi, L., & Yannelis, C. (2020). Does climate change affect real estate prices? Only if you believe in it. *Review of Financial Studies*, 33(3), 1256–1295. doi:10.1093/rfs/hhz073
- Begum, M. M., & Momen, M. N. (2021). Global Climate Change and Its. *Encyclopedia of Quality of Life and Well-Being Research*. doi:10.1007/978-3-319-69909-7
- Bunten, D., & Kahn, M. E. (2017). Optimal real estate capital durability and localized climate change disaster risk. *Journal of Housing Economics*, 36, 1–7. doi:10.1016/j.jhe.2017.01.004
- Busby, J. (2018). Warming world: Why climate change matters more than anything else. *Foreign Affairs*, 97, 49.
- Cazenave, A., & Cozannet, G. L. (2014). Sea level rise and its coastal impacts. *Earth's Future*, 2(2), 15–34. doi:10.1002/2013EF000188
- Change, I. P. O. C. (2007). Climate change 2007: The physical science basis. *Agenda (Durban, South Africa)*, 6(07), 333.
- Christensen, P. H. (2017). A post-global financial crisis (GFC) framework for strategic planning, assessment and management decision making for US sustainable commercial real estate. *Journal of Property Investment & Finance*, 35(6), 589–618. doi:10.1108/JPIF-11-2016-0085
- Christophers, B. (2019). Environmental beta or how institutional investors think about climate change and fossil fuel risk. *Annals of the Association of American Geographers*, 109(3), 754–774. doi:10.1080/024694452.2018.1489213
- Dalhaus, T., Musshoff, O., & Finger, R. (2018). Phenology information contributes to reduce temporal basis risk in agricultural weather index insurance. *Scientific Reports*, 8(1), 1–10. doi:10.1038/41598-017-18656-5 PMID:29311587
- Dixon, G., Bullock, O., & Adams, D. (2019). Unintended effects of emphasizing the role of climate change in recent natural disasters. *Environmental Communication*, 13(2), 135–143. doi:10.1080/17524032.2018.1546202
- Francart, N., Larsson, M., Malmqvist, T., Erlandsson, M., & Florell, J. (2019). Requirements set by Swedish municipalities to promote construction with low climate change impact. *Journal of Cleaner Production*, 208, 117–131. doi:10.1016/j.jclepro.2018.10.053
- Fu, X., Song, J., Sun, B., & Peng, Z. R. (2016). “Living on the edge”: Estimating the economic cost of sea level rise on coastal real estate in the Tampa Bay region, Florida. *Ocean and Coastal Management*, 133, 11–17. doi:10.1016/j.ocecoaman.2016.09.009
- Geiger, P., Cajias, M., & Bienert, S. (2013). The asset allocation of sustainable real estate: A chance for a green contribution? *Journal of Corporate Real Estate*, 15(1), 73–91. doi:10.1108/JCRE-11-2012-0029

Nexus of Climate Change and Sustainable Real Estate

- Giglio, S., Maggiori, M., Stroebel, J., & Weber, A. (2015). *Climate change and long-run discount rates: Evidence from real estate (No. w21767)*. National Bureau of Economic Research. doi:10.3386/w21767
- Hebb, T., Hamilton, A., & Hachigian, H. (2010). Responsible property investing in Canada: Factoring both environmental and social impacts in the Canadian real estate market. *Journal of Business Ethics*, 92(1), 99–115. doi:10.1007/10551-010-0636-5
- Heberger, L., Kirsch, B., Donhauser, T., Nissle, S., Gurka, M., Schmeer, S., & Aurich, J. C. (2016). Influence of the quality of rivet holes in carbon-fiber-reinforced-polymer (CFRP) on the connection stability. *Procedia Manufacturing*, 6, 140–147. doi:10.1016/j.promfg.2016.11.018
- Jackson, J. (2009). How risky are sustainable real estate projects? An evaluation of LEED and ENERGY STAR development options. *Journal of Sustainable Real Estate*, 1(1), 91–106. doi:10.1080/10835547.2009.12091790
- Kauškale, L., & Geipele, I. (2017). Integrated approach of real estate market analysis in sustainable development context for decision making. *Procedia Engineering*, 172, 505–512. doi:10.1016/j.pro-eng.2017.02.059
- Keenan, J. M., Hill, T., & Gumber, A. (2018). Climate gentrification: From theory to empiricism in Miami-Dade County, Florida. *Environmental Research Letters*, 13(5), 054001. doi:10.1088/1748-9326/aabb32
- Kemp, A. C., Dutton, A., & Raymo, M. E. (2015). Paleo constraints on future sea-level rise. *Current Climate Change Reports*, 1(3), 205–215. doi:10.1007/40641-015-0014-6
- King, A. D., Butler, A. H., Jucker, M., Earl, N. O., & Rudeva, I. (2019). Observed relationships between sudden stratospheric warmings and European climate extremes. *Journal of Geophysical Research, D, Atmospheres*, 124(24), 13943–13961. doi:10.1029/2019JD030480
- Kogan, F., Guo, W., & Yang, W. (2020). Near 40-year drought trend during 1981-2019 earth warming and food security. *Geomatics, Natural Hazards & Risk*, 11(1), 469–490. doi:10.1080/19475705.2020.1730452
- Kulp, S. A., & Strauss, B. H. (2019). New elevation data triple estimates of global vulnerability to sea-level rise and coastal flooding. *Nature Communications*, 10(1), 1–12. PMID:30602773
- Lindsey, R. (2018). Climate change: global sea level. *ClimateWatch Magazine*. Available on: http://arizonaenergy.org/News_17/News_Sep17/ClimateChangeGlobalSeaLevel.html
- Locatelli, L., Guerrero, M., Russo, B., Martínez-Gomariz, E., Sunyer, D., & Martínez, M. (2020). Socio-economic assessment of green infrastructure for climate change adaptation in the context of urban drainage planning. *Sustainability*, 12(9), 3792.
- McAlpine, S. A., & Porter, J. R. (2018). Estimating recent local impacts of sea-level rise on current real-estate losses: A housing market case study in Miami-Dade, Florida. *Population Research and Policy Review*, 37(6), 871–895. doi:10.1007/11113-018-9473-5 PMID:30546178
- McMichael, C., Dasgupta, S., Ayeb-Karlsson, S., & Kelman, I. (2020). A review of estimating population exposure to sea-level rise and the relevance for migration. *Environmental Research Letters*, 15(12), 123005. doi:10.1088/1748-9326/abb398

- Mees, H. L., Uittenbroek, C. J., Hegger, D. L., & Driessen, P. P. (2019). From citizen participation to government participation: An exploration of the roles of local governments in community initiatives for climate change adaptation in the Netherlands. *Environmental Policy and Governance*, 29(3), 198–208. doi:10.1002/eet.1847
- Muldoon-Smith, K., & Greenhalgh, P. (2019). Suspect foundations: Developing an understanding of climate-related stranded assets in the global real estate sector. *Energy Research & Social Science*, 54, 60–67. doi:10.1016/j.erss.2019.03.013
- Murfin, J., & Spiegel, M. (2020). Is the risk of sea level rise capitalized in residential real estate? *Review of Financial Studies*, 33(3), 1217–1255. doi:10.1093/rfs/hhz134
- Nerem, R. S., Beckley, B. D., Fasullo, J. T., Hamlington, B. D., Masters, D., & Mitchum, G. T. (2018). Climate-change-driven accelerated sea-level rise detected in the altimeter era. *Proceedings of the National Academy of Sciences of the United States of America*, 115(9), 2022–2025. doi:10.1073/pnas.1717312115 PMID:29440401
- Nordhaus, W. (2019). Climate change: The ultimate challenge for economics. *The American Economic Review*, 109(6), 1991–2014. doi:10.1257/aer.109.6.1991
- Owusu, P. A., & Asumadu-Sarkodie, S. (2016). A review of renewable energy sources, sustainability issues and climate change mitigation. *Cogent Engineering*, 3(1), 1167990. doi:10.1080/23311916.2016.1167990
- Rhodes, C. J. (2016). The 2015 Paris climate change conference: COP21. *Science Progress*, 99(1), 97–104. doi:10.3184/003685016X14528569315192 PMID:27120818
- Ryghaug, M., Holtan Sørensen, K., & Næss, R. (2011). Making sense of global warming: Norwegians appropriating knowledge of anthropogenic climate change. *Public Understanding of Science (Bristol, England)*, 20(6), 778–795. doi:10.1177/0963662510362657 PMID:22397085
- Sadineni, S. B., Madala, S., & Boehm, R. F. (2011). Passive building energy savings: A review of building envelope components. *Renewable & Sustainable Energy Reviews*, 15(8), 3617–3631. doi:10.1016/j.rser.2011.07.014
- Salman, S. A., Shahid, S., Ismail, T., Ahmed, K., & Wang, X. J. (2018). Selection of climate models for the projection of spatiotemporal changes in temperature of Iraq with uncertainties. *Atmospheric Research*, 213, 509–522. doi:10.1016/j.atmosres.2018.07.008
- Sam-Aggrey, H., & Lanteigne, M. (2020). *Environmental Security in The Arctic*. Routledge Handbook of Arctic Security. doi:10.4324/9781315265797-9
- Self, P. (2021). *Government by the Market? The Politics of Public Choice*. Routledge. doi:10.4324/9780429039393
- Sheldon, T. L., & Zhan, C. (2019). The impact of natural disasters on us homeownership. *Journal of the Association of Environmental and Resource Economists*, 6(6), 1169–1203. doi:10.1086/705398

Nexus of Climate Change and Sustainable Real Estate

- Sun, Q., Miao, C., Hanel, M., Borthwick, A. G., Duan, Q., Ji, D., & Li, H. (2019). Global heat stress on health, wildfires, and agricultural crops under different levels of climate warming. *Environment International*, 128, 125–136. doi:10.1016/j.envint.2019.04.025 PMID:31048130
- Teicher, H. M. (2018). Practices and pitfalls of competitive resilience: Urban adaptation as real estate firms turn climate risk to competitive advantage. *Urban Climate*, 25, 9–21. doi:10.1016/j.uclim.2018.04.008
- ULI-Heitman. (2019). *Climate Risk and Real Estate Investment Decision-Making: New Report from ULI and Heitman*. Available from: www.heitman.com/news/climate-risk-and-real-estate-investment-decision-making/
- Ulubeyli, S., & Kazanci, O. (2018). Holistic sustainability assessment of green building industry in Turkey. *Journal of Cleaner Production*, 202, 197–212. doi:10.1016/j.jclepro.2018.08.111
- Vu, D. T., Yamada, T., & Ishidaira, H. (2018). Assessing the impact of sea level rise due to climate change on seawater intrusion in Mekong Delta, Vietnam. *Water Science and Technology*, 77(6), 1632–1639. doi:10.2166/wst.2018.038 PMID:29595165
- Warren-Myers, G., Hurlimann, A., & Bush, J. (2020). Barriers to climate change adaption in the Australian property industry. *Journal of Property Investment & Finance*, 38(5), 449–462. doi:10.1108/JPIF-12-2019-0161
- Westcott, M., Ward, J., Surminski, S., Sayers, P., Bresch, D. N., & Claire, B. (2020). Be prepared: Exploring future climate-related risk for residential and commercial real estate portfolios. *Journal of Alternative Investments*, 23(1), 24–34. doi:10.3905/jai.2020.1.100
- Wieteska-Rosiak, B. (2020). Real Estate Sector in the Face of Climate Change Adaptation in Major Polish Cities. *Real Estate Management and Valuation*, 28(1), 51–63. doi:10.2478/remav-2020-0005
- Williamson, K., Satre-Meloy, A., Velasco, K., & Green, K. (2018). *Climate change needs behavior change: Making the case for behavioral solutions to reduce global warming*. Rare.
- Wolf, D., & Klaiber, H. A. (2017). Bloom and bust: Toxic algae's impact on nearby property values. *Ecological Economics*, 135, 209–221. doi:10.1016/j.ecolecon.2016.12.007
- Zhou, N., Price, L., Yande, D., Creyts, J., Khanna, N., Fridley, D., & Franconi, E. (2019). A roadmap for China to peak carbon dioxide emissions and achieve a 20% share of non-fossil fuels in primary energy by 2030. *Applied Energy*, 239, 793–819. doi:10.1016/j.apenergy.2019.01.154
- Zuo, J., & Zhao, Z. Y. (2014). Green building research—current status and future agenda: A review. *Renewable & Sustainable Energy Reviews*, 30, 271–281. doi:10.1016/j.rser.2013.10.021

Chapter 6

Is Current Understanding Adequate for Green Banking Practices in Nepal: A Lesson Learned

Nirajan Devkota

 <https://orcid.org/0000-0001-9989-0397>

Quest International College, Pokhara University, Lalitpur, Nepal

Udaya Raj Paudel

Quest International College, Pokhara University, Lalitpur, Nepal

Ghanashyam Khanal

Tribhuvan University, Kathmandu, Nepal

ABSTRACT

Going green, in recent days, has been a buzzword for both global banking and financial sectors and for the general public. Green banking as a part of “going green,” referring to the environmentally friendly practices that reduce the carbon footprint by using online services, is a new way of performing the banking businesses considering the clean environmental issues as well as the corporate social responsibility of banks. In this context, this chapter offers an improved understanding of the importance of adopting green banking in the Nepalese banking industry. This chapter uses a mixed-method of analysis – both primary and secondary data were used. The customers and bankers are found to have less awareness regarding the concept of green banking practices in the Nepalese context. In order to promote green banking practices, the banks and governments are required to be aware of the people with the help of some effective policy interventions.

DOI: 10.4018/978-1-7998-7967-1.ch006

GREEN BANKING: AN EMERGING CONCEPT

Going green, in recent days, has been a buzzword for both global banking and financial sectors and for the general public (Trehan, 2015). Green banking as a part of “going green” is a new way of performing the banking businesses considering the clean environmental issues as well as corporate social responsibility of banks (Islam & Das, 2013). It refers to the environmental- friendly practices that reduce the carbon footprint by using online services for banking activities to contribute to environmental protection with green banking products (Mehedi & Kuddus, 2017). Rationalizing the strategies, policies and activities pertaining to banking services, businesses and in-house operational activities, the banks can run the efforts of green practices to keep the environment green and to minimize greenhouse effects (Deka, 2015). To adopt the green banking concept in banks, a basic understanding of proper environment management, its strategies and policies are the essentials (Mehedi & Kuddus, 2017).

All over the world in the last few decades, the government, business firms, policy-makers, advocacy groups and even public talks are centered on environmental issues in one or the other way (Shaumya & Arulrajah, 2017). In this context, green banking has become a massive trend within the global banking industry which helps to reduce the pollution raised from banking operations. So, banks, directly or indirectly, are putting their efforts in minimizing environmental pollution by supporting the people and institutions with finance as a part of their duty to encourage the environmental-friendly businesses (Thombre, 2011). They play a vital role to safeguard the planet from unusual weather patterns, rising greenhouse gas, and declining air quality, with the aim of ensuring economic growth which is sustainable (Islam & Kamruzzaman, 2015). Furthermore, (Sahoo & Nayak, 2007) suggested that banks, as a part of their lending principle, should go green and play a pro-active role to protect environmental and ecological aspects in the long-run.

The first green bank named “First Green Bank”, was established in Mt. Dora, Florida, the United States in 2009 (Jayabal & Soundarya, 2016). “Bangladesh Bank” is the first bank to initiate the concept of green banking conceptually in 2011 (Masukujjaman & Aktar, 2013). In this regard, (Afroz, 2017) has illustrated that the green banking initiatives in Bangladesh involve both the in-house which indicates the management of energy, prevention of wastage of energy and paper within the banking premises and other than in-house which is related with green banking financing and making the customers and stakeholders aware of environmental issues.

In this global scenario of environmental degradation, Nepalese financial sectors can play a significant role as one of the key stakeholders in protecting the environment. The government of Nepal is trying to make cities clean and green with less carbon emission and for this purpose, banks are encouraged to invest in clean energy and be updated on various facets of environmental issues (Belás, Korauš, Kombo, & Korauš, 2016). The statistics reveal that in Nepal the number of ATMs reached 318, internet banking users 893 thousand, mobile banking users 7 million, debit card users 6.28 million and credit card users 113 thousand until mid-April 2019 (NRB, 2020).

Studies show that green banking poses several advantages over traditional banking. Green banking helps in reducing internal carbon footprint as well as external carbon emission (Jha & Bhome, 2013; Risal & Joshi, 2018). Again, (Rajesh & Dileep, 2014) asserted that banks also contribute to ecological footprint directly and indirectly through investment and lending in their customer enterprises. Moreover, green banking plays a caring role for sustainable development in overcoming the institutional obstacles and market challenges, in the way to allocating the investment to green projects (Uddin & Ahmmed, 2018). So, if banks follow green banking practice it would improve employee’s health and safety through

a reduction in the use of hazardous resources. They prioritized mobile money service and internet banking to avoid customer-counter delay and provide access to easy finance.

Providing loans to firms that have concern for the environment would also ensure proper utilization of natural resources (Arumugam & Chirute, 2018). For example, It is found that customers are unaware with the term Green banking even they are enjoying the benefits and features of green banking (Pariag, Maraye, Munusami & Ansaram, 2017). Almost all of the studies on green banking from different countries even in Nepal also revealed that customers are less aware about the green banking.

Despite having inadequate awareness regarding green banking practices, the consumers show their interests in environmental-friendly banking products and services so, they have higher expectations towards the financial institution should take environmental protection responsibilities and this is the reason behind going green financial institutions (Sharma, Sarika, & Gopal, 2014). Customers' satisfaction and expectation will be different as per customer's comparative analysis between the perception and services performance because the success of any organization depends on how the customers understand them and their services (Parasuraman, Berry, & Zeithaml, 1991). Since the banking sector is one of the capital sources of business and industries, it makes them feel accountability and responsibility to measures the negative impact on the environment from those businesses and industries to whom they financing. They introduced different schemes that support environmental protection and somehow customers were used but they don't know green banking terms and their concept brings in banking activities.

Laxmi bank is the initiator of green banking concepts and strategies in Nepal (Mehta & Sharma, 2016). The study made by Sharma et al. (2014) concluded that Nepalese customers think online transactions, online bill payments and point of sales systems as green banking but they do not have a proper understanding of the Green CDs, solar-powered ATMs, and bonds for environment protection.

Though the current knowledge production on green banking in the Nepalese context has highlighted clean environmental issues as well as corporate social responsibility, they are not adequate enough to direct the ways forward in formulating the policies at the national level. The study tries to hold a great value, for green banking really helps to protect the environment by adopting environmental-friendly practices and encouraging the environmental-friendly businesses as well. Hence, the studies on green banking require comprehensive analysis considering various facets related to it. In this context, this paper offers an improved understanding of the importance of adopting green banking in the Nepalese banking industry and forwards some recommendations for policy intervention.

The remaining study is structured as follows: section 2 presents a review of literature that supports our study. Section 3 includes the materials and methods used in the study. Section 4 showcases the result and discussion on the topic and final section covers conclusion and recommendations.

LITERATURE REVIEW

In 1980, the concept of green banking was established at Triodos bank from Dutch origin which started the environmental sustainability in the banking sector from the very first day. After the bank launched 'green fund' for funding environment-friendly projects in 1990, all the other banks initiated their projects later (Deepa & Karpagam, 2018). Taking this bank as an example, other banks around the globe exhibited their interests to proceed with green banking initiatives.

Green, generally referred to as something that is related to the natural environment, can be defined as an area of land covered with grass, plants and trees without buildings. "Green" in the discourse of

Is Current Understanding Adequate for Green Banking Practices in Nepal

green banking principally indicates the environmental accountability of banks and their environmental performances in business operations (Biswakarma, 2017). It is a kind of banking that is conducted in selected areas that helps in the reduction of internal carbon footprints and external carbon emissions (Bahl, 2012). Banks can reduce their carbon footprints by embracing the following measures such as paperless banking, energy consciousness, using mass transportation, saving paper, green buildings, going online, use of solar and wind energy (Cholasseri, 2016).

Green banking has several advantages (Ragupathi & Sujatha, 2015) listed as (I) basically, green banking avoids paperwork and almost all the transactions are done through online banking, (II) creates awareness to business people about environmental and social responsibility supporting them to do environmental friendly business practices, and (III) follows environmental standards for lending, which is really an excellent idea and it will make business owners change their business to environmental-friendly which will help greatly for the future generations. Two strategies are suggested which banks should follow to go for green banking. First, the use of paperless banking that helps in reducing the carbon footprints from internal banking operations and cost-saving to banks. Second, the adoption of Green Street lending, which means offering a low rate of interest to consumers and businesses for installing solar energy systems and energy-saving equipments.

Green banking plays a key role in mitigating the risks namely credit risk, legal risk and reputation risk by adopting green banking practices (Dhamija & Sahni, 2018). This study suggests some green banking strategies like carbon credit business, green financial products, green mortgages, carbon footprint reduction, energy consciousness, green buildings and social responsibility services towards the society. Based on the above-mentioned literature, green banking can be as an environment-oriented banking practice that safeguards the environment from the negative impact to achieve the environmental goals of the banks. In this perspective, banks are able to implement several green banking practices such as usage of energy-efficient equipments, environmental training constructing green buildings, etc. Hence, adopting these practices banks can accomplish their environmental goals (Paudel, et al, 2020).

In this context, green banking practices can be taken as good evidence to prove that banks are very keen on reducing their carbon footprint, energy consumptions and environmental issues. It is observed that banks around the world are giving high priority and attention to green banking practices. However, several literatures and studies have been found in the USA, Europe, China, India and Bangladesh regarding 'Green Banking' found that it is highly required that the researcher go for further investigation if these factors hold true for other countries and contexts as well (Shakil, Azam & Raju, 2014).

Customer's and Banker's Perceptions of Green Banking: A Critical Review

These four factors; determining client's satisfaction with a branch (i.e. the speed of service, access of each employee, privacy, and opening hours); economic satisfaction (fees, interest); satisfaction with the remote access (i.e. the level of e-banking), and availability of ATMs which impact on the overall customer satisfaction are pivotal for customers overall satisfaction and banks success (Felix, 2015). Customer's satisfaction can be measured on the basis of these dimension; reliability, fulfillment, efficiency and privacy and security website attributes which has positive significant effect on customer (George & Kumar). In the same vein, (Iqbal, Nisha, & Raza, 2017) observed the behavior or intention of customers by providing them the satisfaction expected from such alternate financial delivery services will influence by the service quality (responsiveness, reliability, privacy, empathy and information quality)

considerably affect the bank's performances of green banking and improvement of these qualities helps to achieve customer's satisfaction.

To the customers, green banking helps to reduce wastage from their lives by eliminating paper waste and also makes their life easier and more secure with online banking by providing facilities like balance enquiry, check balance statement, fund transfer and deposit, opening and closing account and easy-to-access location for prevent identity theft (Wessels & Drennan, 2010). Similarly, green banking saves time and money because you don't have to make numerous trips to bank for the banking activities and it can be done through mobile or electronically where you are (Sahni & Dhamija 2018). Likewise, it also helps for online payment services avoiding late payments and save the fines. Green banking affords substantial benefits to a bank including increased goodwill and reputation, customer's loyalty, positive effects on the environment and simplicity of bank processes which is more than monetary benefits (Vijay & Natarajan, 2015). It also helps corporate sector to increase the awareness about their social responsibilities, environmental activities and maintain their ethical standards (Narteh & Kuada, 2014).

Examining the effect of green banking practices initiatives on customers' satisfaction, (Herath & Herath, 2019) suggested that the usage of green banking products depends on the customer satisfaction level by adoption of green banking products which depends on the various features of green banking initiatives. Iqbal et al. (2017), concentrating the dimension of service qualities of customers' perception on green banking products, investigates service qualities and other underlying factors that determine customer's behavioral intentions towards using green banking in Bangladesh.

A study conducted in Kerala, India explored the usage pattern and understanding of customers on green banking (Pillai, 2019). This study clearly indicated that cost-effectiveness is the serious concern of the customers in the usage of green banking. So, they recommended the banking organizations take measures to inform their customers about the advantages of being green. The study (Sahni & Dhamija, 2018) has adequately addressed the willingness and perception of customers to adopt green banking.

Moreover, another study Masukujjaman et al. (2015) has analyzed the banker's perception on green banking. They studied the concept of green banking, its benefits, difficulties and relation with Islamic banks in Bangladesh. They observed that most of the bankers perceived green banking as an environmental banking and they also believed that it is socially responsible banking and ethical banking. (Shaumya & Arulrajah, 2017), exploring the green banking practices in Sri Lanka, found that several dimensions contribute in the practicing the green banking by motivating employees efforts in creating and sustaining green banking concept in practice. Along with this, it helps to make daily operations activities more environmental friendly, by involving customers in those projects which does not harm the environment and finally by adopting environmental friendly policies, systems and principle to become a greener bank.

Identifying the banker's perceptions regarding the indicators for adopting green banking in commercial banks of Bangladesh, Mehedi et al. (2017) concluded that Bangladesh should take some corrective actions by adopting the concept of green banking. The banker's efforts of the adoption tools and techniques which the banks are currently undertakings are delineated to credit and debit cards, and other internet banking facilities. Likewise, Risal and Joshi (2018) discovered a positive impact of practicing green banking on the bank's environmental performances in the Nepalese context. Despite the increasing concerns for protecting the environment around the globe, there seems to be a research gap in this area in the context of Nepal. There are very few studies conducted in this area; therefore, the studies related to green banking need to be discovered in the days to come.

METHODOLOGY

This research has been conducted by using a mixed method of analysis, considering the green banking practices made by banks and customers in Kathmandu valley. Content analysis was done by reviewing studies and grey literature as available from a thorough internet surfing. For the larger picture of the study, the researchers have drawn secondary information from past to the recent publications pertaining to green banking. Secondary data has been used for strengthening research and its findings. The secondary data were gathered from articles, journals, annual reports of banks, publications of National Planning Commission (NPC), and report from the publication of Sustainable Development Goals (SDGs), books, newspapers, banking documents, electronic media, as well as published and unpublished documents of various research institutions. The field based data were drawn from two previous cross-sectional researches- 403 customer's perspectives (Rai, 2019) and the banker's perspectives with 326 banking employees (Tandukar, 2019). Hence, the research mainly focuses on descriptive methodology and desk review. For most of the people of Kathmandu valley hold their transactions through bank account, the Kathmandu valley was suitable area for research because it has a largest population of Nepal. In this sense it is important to analyze the impact of proximity to urban areas in terms of access to ICTs and climate change awareness in the banking sectors.

Study Area

As the banking sectors of Nepal recently are trying to adopt the green banking practices on their banking services and they feel a need to start an e-banking facility which will benefit both customers as well as the environment, such studies hold a seminal impact in the field. Kathmandu valley is the center for different major industries such as carpets, garments, finance, tourism, health, educational services, as well as, banking services. The total population of Kathmandu is 1,442,271 which has the largest population than other district (CBS, 2020). Shortage and lacking of service, and infrastructural development in many parts of Nepal have forced and made Kathmandu valley a hub for many businesses and service activities. Present scenario shows the rapid growth of banking industry in Kathmandu Valley of Nepal. Therefore, the Kathmandu Valley was suitable area for research because it has a largest population of Nepal and there is importance of analyzing the impact of proximity to urban areas in terms of access to ICTs and climate change awareness in the banking sectors. The present study area chosen for the study is Kathmandu Valley - Kathmandu, Lalitpur and Bhaktapur districts are the three areas of the valley, which are located in Bagmati province. Both the employee and customers from all 28 A grade commercial banks operating in Kathmandu are the population for the study. There are currently 28 'A grade' Commercial Banks registered in Nepal Rastra Bank, a central governing body of Nepal and 'A grade' is allotted to the Commercial banks with paid-up capital of NRs 8 billion (\approx USD 70 Million).

EMPIRICAL RESULTS AND DISCUSSION

Customer's Perceptions on Green Banking

Green banking is the application of eco-friendly banking services by financial institutions in their service delivery. Green banking considers the interest of the stakeholders while promoting their banking

Is Current Understanding Adequate for Green Banking Practices in Nepal

practices (Mehedi and Kuddus, 2017). As identified in a study (Rai, 2019). the customers' perception on green banking practice by focusing on the awareness level, importance of green banking, opinion on green banking, effectiveness level, benefits of green banking, determinants of green banking, problems of green banking, environmental conservation. It was found that 96% of the respondents are less aware about the green banking practices and 4% moderately and only 1 respondent are highly aware (Rai, 2019). It is implied that bank should focus on encouraging and work into promote the concept towards their customers Dixit & Saroj, 1970; Sharma et al., 2014; Vijai & Natarajan 2015; Deka 2015; Mehta & Sharma, 2016; Malliga & Revathy, 2016; Pariag-maraye et al., 2017; Risal & Joshi, 2018).

Similarly, very few 12% respondents think that green banking concept is not important because they are unknown about the benefits of green banking practices but the majority of respondents 88% thinks important, it will benefit customers, banks and society (Rai, 2019). It indicates that green banking concept in financial institution is necessary in current context to change the traditional way of banking transaction into technological banking (Sathye, 1999); Mehta & Sharma, 2016; Malliga & Revathy, 2016).

41% of respondents agree on green banking is the environmental banking which means customers perceived the green banking as to solve the environmental problem (Rai, 2019). It means customers are known about green banking practices is environmental friendly concept that promote and contribute to protect environment. So, bank should adopt the environmental friendly practices by focus to keep environment clean and healthy through reducing carbon foot print rise by banking activities (Sharma, Sarika & Gopal, 2014; (Raj & Rajan, 2017). To solve the problem of environmental degradation and upgrade the banking services with technology to develop the nation Nepal needs to work hard. The reason of that is bank and financial institution play vital role to maintain sustainability growth by financing the environmental friendly activities and change the customers habits by introduce green products and services.

Recently, the green banking practices adopt by Nepalese banking and respondents thought that the success and improve the concept will be determine by the environmental policy (38%) and green policy by bank (25%) more than other factors (Rai, 2019). Green banking has benefits to both the banks and customers, on that context respondents said that green banking concept helps to attract customers (18%), cover CSR (18%) to the banks and for customers it helps to protect environment (20%) and accelerate service delivery (9%) that saves both time and money and facilitate to do banking transaction easily from anywhere (Parajuli, Paudel and Devkota, 2020). Not that much but also reduce the stationary cost and raise profit of both banks and customers. Green banking is a new concept and not much people are familiar with so, there is problem like lack of education, data security, comfortable with traditional method, lack of infrastructure.

Similarly a study (Rai, 2019) found that the received training, green banking advocate's cleanliness, technical issue and reduce stationary cost were significant at 5% level while green mortgage and green checking account were significant at 1% level and reduce resource wastage were significant at 10% level However, operational wealth of bank had a significant negative relationship (at 5% level), lack of infrastructure (at 10% level), raise profit (at 1%level). Looking at their odds ratio, the result indicated that for one unit change in received training, green mortgage, green banking advocate cleanliness, green checking account, technical issue and reduce resource wastage, the odds of being awareness on green banking increase by a factor of 17 times, 3.8 times, 2 times, 2.95 times, 2.24 times, 1.9 times and 2.6 times respectively (Paudel et. al, 2019). This result implied that training is one of the most important factors to encourage green banking among the customers.

To understand the customer's expectation, the organizations need to know about what customers really want from a product and services. If the services provided are below the minimum expectation level,

Is Current Understanding Adequate for Green Banking Practices in Nepal

then the customer's expectation will not meet and if the delivered service exceeds the desired service, they were satisfied (Zeithaml, Bitner, Gremler, & Pandit, 2013). Nowadays, customers expect cashless activities and 24 hours access to electronic banking so, green banking offers e-cards, internet banking, ATMs (Alinvi, 2009). As a solution to global warming customers like the idea of saving energy, for these banks make their infrastructure environment –friendly by using laptops, desktops computers, resource-efficient environmentally responsible green building to meet customer's expectations (IDRBT, 2013).

Every bank following the environment directed guidelines which help to increase green concern among stakeholders, customers believe that the financial institutions will endorse by the guidelines (Islam et al., 2015). Customers' perception towards the green banking practices depends on how much their banks are committed towards the green, environmentally friendly and follow ethical policies that determine the green banking products and services (Ganesan & Bhuvanewari, 2016). The factors that influence the customers' satisfaction spirit of ethics which includes lower transaction cost, better deposit rate, maintain a high degree of ethical standards and eco-friendly technology (Shampa & Jobaid, 2017).

The studies discussed above help to know the customer's perceptions towards the green banking practices. Customers are ready to adopt green banking practices but there is a problem that they are not familiar with it. This means banks and governments should focus on rising awareness about the concept of green banking and make a policy that supports the practices. (Kharel, Kharel, Chaurasiya, Maharjan, & Rijal, 2019) urge that banks of Nepal are performing quite because of strict supervision, the guidance of Nepal Rastra Bank. If NRB shows similar robustness in the context of green banking practices, then banks of Nepal can adopt green banking practices easily and make customers well known about it through the initiation of various awareness programs.

Banker's Perceptions of Green Banking

Green banking protects the environment, which is what the sampled bankers mostly agreed upon, i.e., the common idea about green banking among the bankers is limited within the environmental consciousness (Masukujjaman, R. Md, S. Chamhuri, & S.S. Alam, 2015). Among various banking services, mobile banking (32%) is the most common service that is being used by all the banks. Second, mostly used service is online banking (27%) followed by saving paper while the other are ethical banking, power supply equipment, remote deposits, use of solar energy, green checking account, green loan, green credit card, green saving accounts, green mortgage, and green money market accounts. Almost two-third (62.27%) respondents are aware that green banking provides significant benefits to the customers. The majority of the respondents (59.20%) think green banking initiatives help in contributing sustainable development and 69.02% think environmental conservation and sustainable growth in the future are possible due to green banking initiatives. Out of them, 134 respondents are aware about its benefits. Likewise, 57.98% of respondents feel that the green banking is important in terms of change in climate and most of the respondents are highly aware in this regard (Tandukar, 2019).

Technology is an important factor for the easy and smooth provision and adoption of green banking. As per the perception of respondents the existing technology is not sufficient (33.74% respondent) to promote green banking while only 70 respondents feel that the existing technology in their bank is sufficient for promoting green banking. Similarly, regarding readiness for green banking 38.65% respondents are ready for green banking but 36.81% respondents are still confused in accepting green banking in their bank because of the lack of 9 training and knowledge regarding the green banking's importance (Tandukar, 2019).

Is Current Understanding Adequate for Green Banking Practices in Nepal

The concept of green banking involves promoting social responsibility in protecting the environment. Coalition for Green Capital (2016) defines green banks as public institutions that fund energy renewal projects, energy efficiency, and clean energy project, partners with private lenders. Green banks are capitalized through the public fund, thus being used to lend, lease, credit and financial service to minimize the gap between private capital markets as an energy renewal project. The study outlined represented that the adoption of green banking is determined by the pressure from governmental units, environmental pollution control policies, social group pressure and pressure from the different national and international organizations (Shrestha et. al, 2020).

Similarly, another study (Schub, 2015) stated that green banks only invest in those projects that are economical with proven technologies, loaners or project owners are being able to save money from reducing the carbon emission and energy savings. It indicates green banking plays a caring role for sustainable development in overcoming the institutional obstacles and market challenges to allocating investment into various green projects (Uddin & Ahmmed, 2018).

The foremost contribution of this research is that it has explored the ongoing banking green practice and their customers' expectations towards the new concept of green banking practices. This research finds that the practices have a huge potential in Nepal if banks able to introduced the concept towards the customers and benefited both the customers and banks which is significant for the development of the nation. The findings are also supported by earlier research made by Mehta & Sharma (2016) and Risal & Joshi (2018). Currently, NRB has made mandatory for banks and financial institutions to invest a certain percentage of their profit in CSR activities (Parajuli, Rajbhandari, Joshi, Sujan, & Bhandari, 2019). Keeping this factor in the limelight if banks start promoting their green banking practice among customers through various programs this would help banks to strengthen their CSR part as well as help banks to aware customers which will eventually benefit the bank.

There are some limitations in this study. This study only accounts 'A grade' commercial banks and left other B, C and D grades bank prevails in Kathmandu, Nepal. This study does not look how bankers' of development banks, finance companies and micro finance institutions perceives green banking practices in their respective organizations. Despite these limitations, this study makes significant contribution to understanding green banking practice by banks and customers reaction on that practice. It has opened avenue for future research in Nepal.

CONCLUSION AND RECOMMENDATIONS

The concept and issues of green banking in the context of Nepalese banking and financial institutions are still new compared to other countries. Green banking plays a caring role for sustainable development in overcoming the institutional obstacles and market challenges to allocating investment into various green projects (Uddin & Ahmmed, 2018). From this study, we came to know the very Banking staff (38.65%) are ready for green banking practices in their banks. The major problems are less aware of the practices adopted by their banks and the benefits of it. Interestingly, there is a positive response of the customers towards the practices and ready to adopt green banking practices. Also, customers feel that green banking practices are important to them. Based on the conclusions derived following recommendations are provided to the concerned authorities.

Recommendation for Banking Involvement to Green Banking Practices

- ***Provide Training to Employees:*** The study shows that only 10% of bankers have received training on green banking practices inside and outside their office. Therefore, first of all, banks should initiate green banking products and services in their banks and they should provide proper training to their employees for effective implementation of green banking practices.
- ***Reduce Paper Consumption:*** The main focus of green banking is to reduce paper consumption from banking operations that also helps to decrease the stationary cost of the banks. The result of the study reveals that 48.46% of the respondents think green banking helps to reduce stationary cost and 38.04% of the respondents think the reduction of paper consumption helps to raise profits of banks. Hence, all banks should reduce the maximum use of paper consumption in their daily operations.
- ***Provide Effective Online Services:*** Nowadays, with the advancement in information technology, most of the customers used online services like mobile banking, online banking, internet banking, remote deposits, etc. to pay their utility bills, deposits, and transfers balance. The need for effective online services by banks is increasing. The result of the study also shows that most of the commercial banks in Kathmandu Valley are providing the top five green banking services like mobile banking, online banking, save paper, ethical banking and green saving account. Therefore, banks should provide effective online services to customers for proper implementation and promotion the green banking.
- ***Increase Awareness:*** The awareness index result indicates that 76.38% i.e. 249 of the respondents are less aware of green banking practices in their banks. The awareness level of bankers on green banking practices is very low so the banks should increase their awareness level by providing them proper information during meetings and workshops about green banking practices in their banks.
- ***Informed about NRB Regulations:*** The result shows that only 16.25% of the respondents are aware of the regulations from NRB for green banking. The majority of the respondents are unknown about any regulations from NRB for green banking. Recently, government agencies are paying special attention to the green banking concept as it prevents the environment and provides cost-effective practices in the banking sector. The regulations formulated by NRB should be implementing by all banks and bankers' should be aware of the policies and provisions made for the green banking. It helps to adopt the green banking initiatives and promote green banking practices.

Recommendations for Enhancing Customers' awareness of Green Banking Practice:

- ***Increased Awareness Level:*** The main problems of the adoption of green banking practices in Nepal are lack of awareness about the concept. Only 22 percentage of respondents aware of green banking practices which means the majority of the customers is unknown about the concept. So, banks should organized seminars, workshops and training that make the green banking practices familiar among customers. As mentioned by Tandukar et al. (2019) NRB maintains the right to enhance public credibility towards banks and financial institutions. So, NRB should bring such policies which would force banks to initiate programs which would aware customers about green banking practice.

- **Understand the benefits of green banking practices to increase the scope of green banking practices:** 87 percent respondents said green banking practices is the importance that indicates that the green banking practices is very important in present context. Similarly, 83 percent respondents feel green banking products effective compared to other modes of banking which shows the green banking products have effective than other in customer's perception. But only 117 customers out of 403 are ready to adopt green banking practice because people do not know about the benefits and problems of green banking because lack of awareness about the concept. To increase the scope of the green banking practices the customers' needs to use the green financial products and services for that it is necessary to understand the benefits of the using green banking service than other financial services.
- **Reduce the problem of the green banking:** The major reason that affects the use of green banking products (online transaction) by the customers is security and privacy. However, it is mostly depend on the users so, the user's needs to strictly follow the guidelines provided by their banks. And for the problem of hacking bank should take appropriate measures in order to prevent such practices.
- **Role of government:** The government policies were supported the green concept of banks by providing incentives and discount by spend from cards and so on. It's a government and banks have a responsibility to aware the policy made by the government to the customers and follow the policy made by the government.

Therefore, the research foresees that if the banks and financial institutions are able to educate the customers about the green banking practices, their benefits and solve the problem that arise during the adaptation of green banking by the customers, then customers inclination will induce the banks to adopt such practices. It means that before the adoption the new concept in banks and financial institutions they should introduce their new concept to customers and bankers who are the users and their perceptions towards the practices means a lot.

REFERENCES

- Afroz, N. N. (2017). Green banking initiatives of Islamic bank Bangladesh limited. *Global Journal of Management and Business Research*, 17(1), 1–8.
- Alinvi, F. (2009). *Customers' expectations of banks becoming cashless-how could banks meet customer's expectations when changing from cash services to deeper customer relationship?* Retrieved in July 20, 2016 from www.divaportal.org/smash/get/diva2:220556/FULLTEXT01.pdf
- Arumugam, D., & Chirute, T. (2018). Factors determining the adoption of green banking amongst commercial banks in Malaysia. *Electronic Journal of Business & Management*, 5, 50–62.
- Bahl, S. (2012). Green banking - the new strategic imperative. *Asian Journal f Research in Business Economics and Management*, 2, 176–185.
- Belás, J., Korauš, M., Kombo, F., & Korauš, A. (2016). Electronic banking security and customer satisfaction in commercial banks. *Journal of Security and Sustainability Issues*, 5(3), 411–422. doi:10.9770/jssi.2016.5.3(9)

Is Current Understanding Adequate for Green Banking Practices in Nepal

Biswakarma, G. (2017). Sustainability and green banking practices: Understanding the strategic convergence in Nepalese banks- sem approach. *European Journal of Management*, 17(2), 251–265. doi:10.18374/EJM-17-2.3

Cholasseri, S. (2016). Green banking –an overview. *International Journal of Advance Research and Innovative Ideas in Education*, 1(4), 108–111.

Deepa, P., & Karpagam, C. (2018). A study on customer's awareness on green banking in selected public and private sector banks with reference to Tirupur. *International Journal of Advanced Research and Development*, 3(1), 58–63.

Deka, G. (2015). Green Banking Practices: A Study on environmental strategies of banks with special reference to State bank of India. *Indian Journal of Commerce and Management Studies*, 6(3), 11–19.

Dhamija, A., & Sahni, D. (2018). Green banking: Perception and willingness of customer to adapt green banking. *International Journal of Financial Management*, 7(2), 1–8.

Dixit, N., & Saroj, K. (1970). Acceptance of e-banking among adult customers: An empirical investigation in India. *Journal of Internet Banking and Commerce*, 15(2), 1–17.

Felix, K. (2015). Factors for customer satisfaction and customer dissatisfaction in commercial banks. *Mediterranean Journal of Social Sciences*, 6(4), 584–589. doi:10.5901/mjss.2015.v6n4s2p584

Ganesan & Bhuvanewari, A. (2016). Customer perception towards green banking. *IOSR Journal of Economics and Finance*, 7(5), 5-17.

George, A., & Kumar, G. (2014). Impact of service quality dimensions in internet banking on customer satisfaction. *Journal of Mathematics and Computer Science*, 41(1), 73–85.

Herath, H. M., & Herath, H. (2019). Impact of green banking initiatives on customer satisfaction: A conceptual model of customer satisfaction on green banking. *OSR Journal of Business and Management*, 21(1), 24–35.

IDRBT. (2013). *Green Banking for Indian Banking Sector*. Institute for Development and Research in Banking Technology, Hyderabad, India. [https://www.idrbt.ac.in/assets/publications/Best%20Practices/Green%20Banking%20Framework%20\(2013\).pdf](https://www.idrbt.ac.in/assets/publications/Best%20Practices/Green%20Banking%20Framework%20(2013).pdf)

Iqbal, M., Nisha, N., & Raza, S. (2017). Customers' perceptions of green banking: examining service quality dimensions in Bangladesh. *Green Business: Concepts, Methodologies, Tools, and Applications*, 1071-1090.

Islam, A., & Kamruzzaman, M. (2015). Green banking practices in Bangladesh. *IOSR Journal of Business and Management*, 14(4), 37–42.

Islam, M. S., & P. C. Das. (2013). Green Banking practices in Bangladesh. *IOSR Journal of Business and Management*, 8(3), 39-44.

Jayabal, G., & Soundarya, M. (2016). Green Banking: As banks initiative for sustainable development. *International Journal of Management*, 7(7), 276–280.

- Jha, N., & Bhome, S. (2013). A study of green banking trends in India. *International Monthly Referred Journal of Research in Management and Technology*, 2, 127-132.
- Kharel, S., Kharel, S., Chaurasiya, N., Maharjan, S., & Rijal, C. (2019). Transparency and accountability in the Nepalese corporate sector: A critical assessment. *Quest Journal of Management and Social Sciences*, 1(1), 1–25. doi:10.3126/qjmss.v1i1.25972
- Malliga, A. L., & Revathy, K. (2016). *Customers awareness on green banking- an initiative by private sector bank in Theni district*. Academic Press.
- Masukujjaman, Md, Chamhuri, & Alam. (2015). Banker's perception on green banking-an empirical study on Islamic banks in Bangladesh. *Management & Marketing*, 8(2).
- Masukujjaman, M., & Aktar, S. (2013). Green banking in Bangladesh: A commitment towards the global. *Journal of Business and Technology (Dhaka)*, 8(1-2), 17–40. doi:10.3329/jbt.v8i1-2.18284
- Mehedi, S., & Kuddus, M. A. (2017). Green Banking: A case study on Dutch-Bangla bank ltd. *Academy of Accounting and Financial Studies Journal*, 21(2), 1–20.
- Mehta & Sharma. (2016). Customers' persistence for green banking in Nepal. *Asian Journal of Research in Banking and Finance*, 6(10), 30-44.
- Narteh, B., & Kuada, J. (2014). Customer satisfaction with retail banking services in Ghana. *Thunderbird International Business Review*, 56(4), 353–371. doi:10.1002/tie.21626
- NRB. (2020). *Financial Stability Report, Fiscal Year 2018/19. Kathmandu, Nepal: Banks and Financial Institutions Regulation*. Department Financial Stability Unit, Nepal Rastra Bank. <https://www.nrb.org.np/contents/uploads/2020/07/FSR-2018-19.pdf>
- Parajuli, S., Paudel, U. R., & Devkota, N. (2020). Banking Communications: A Perceptual Study of Customer Relations. *South Asian Journal of Social Studies and Economics*, 8(3), 23–34. doi:10.9734/ajsse/2020/v8i330212
- Parajuli, S., Rajbhandari, S., Joshi, A., Sujana, K., & Bhandari, U. (2019). Transforming corporate governance through effective corporate social responsibility (CSR) and social entrepreneurship orientation in Nepal. *Quest Journal of Management and Social Sciences*, 1(1), 26–49. doi:10.3126/qjmss.v1i1.25973
- Parasuraman, A., Berry, L., & Zeithaml, V. (1991). Understanding customer expectations of service. *Sloan Management Review*, 32(3), 39–48.
- Pariag-Maraye, N., Munusami, N., & Ansaram, K. (2017). A customer's perspective of green banking: A case study of commercial banks in Mauritius. *Theoretical Economics Letters*, 7(07), 19–75. doi:10.4236/tel.2017.77134
- Paudel, U. R., Parajuli, S., Devkota, N., & Mahapatra, S. K. (2020). *What determines customers' perception of banking communication? An empirical evidence from commercial banks of Nepal*. *Global Economy Journal*, doi:10.1142/S2194565920500190
- Pillai, R. (2019). *Perspective and usage patterns of green banking services: A cross-sectional analysis of customers from selected banks in Kerala*. Academic Press.

Is Current Understanding Adequate for Green Banking Practices in Nepal

- Ragupathi, M., & Sujatha, S. (2015). Green banking initiatives of commercial banks in India. *International Research Journal of Business and Management*, 8(2), 74–81.
- Rai, R. (2019). *Customers perception on green banking practices in commercial banks of Kathmandu, Nepal* (MBA) Quest International College, Pokhara University.
- Raj, D., & Rajan, D. (2017). A Study on the customer awareness on green banking initiatives. *Intercontinental Journal of Finance Research Review*, 5(7), 54–65.
- Rajesh, T., & Dileep, A. (2014). Role of banks in sustainable economic development through green banking. *International Journal of Current Research and Academic Review*, 5(2), 22-34.
- Risal, N., & Joshi, S. (2018). Measuring green banking practices on bank's environmental performance: Empirical evidence from Kathmandu valley. *Journal of Business and Social Sciences*, 2(1), 44–56. doi:10.3126/jbss.v2i1.22827
- Sahni, D., & Dhamija, A. (2018). Green banking: Perception and willingness of customer to adapt green banking. *International Journal of Financial Management*, 7(2), 1–8.
- Sahoo, P., & Nayak, B. P. (2007). Green banking in India. *The Indian Economic Journal*, 55(3), 82–98. doi:10.1177/0019466220070306
- Sathye, M. (1999). Adoption of Internet banking by Australian consumers: An empirical investigation. *International Journal of Bank Marketing*, 17(7), 324–334. doi:10.1108/02652329910305689
- Schub, J. (2015). Green Banks: Growing clean energy markets by leveraging private investment with public financing. *The Journal of Structured Finance*, 21(3), 26–35. doi:10.3905/jsf.2015.21.3.026
- Shakil, M. H., Azam, M., & Raju, M. (2014). An evaluation of green banking practices in Bangladesh. *European Journal of Business and Management*, 6(31), 8–16.
- Shampa, T., & Jobaid, M. (2017). Factors influencing customers' expectation towards green banking practices in Bangladesh. *European Journal of Business and Management*, 9(12), 140–152.
- Sharma, N., Sarika, K., & Gopal, R. (2014). A study on customer's awareness on Green Banking initiatives in selected public and private sector banks with special reference to Mumbai. *IOSR Journal of Economics and Finance*, 2, 28–35.
- Shaumya, K., & Arulrajah, A. (2017). The Impact of Green Banking Practices on Bank's Environmental Performance: Evidence from Sri Lanka. *Journal of Finance and Bank Management*, 5(1), 77–90.
- Shaumya, K., & Arulrajah, A. (2017 August). Green banking practices of selected private sector banks in Sri Lanka. In *Proceedings of the Third Jaffna University International Research Conference*. University of Jaffna.
- Shrestha, S., Devkota, N., Paudel, U., Bhandari, U., & Parajuli, S. (2020). Bankers' Communication Know-how: An Analysis from Commercial Banks of Kathmandu valley. *Quest Journal of Management and Social Sciences*, 2(1), 80–99.
- Tandukar, H. (2019). *Customers perception on green banking practices in commercial banks of Kathmandu, Nepal* (MBA). Quest International College, Pokhara University.

Is Current Understanding Adequate for Green Banking Practices in Nepal

Thombre, K. A. (2011). The new face of banking: Green banking. *Indian Streams Research Journal*, 1(2), 1–4.

Trehan, R. (2015). Green banking in India. *Journal of Poverty. Investment and Development*, 14, 27–32.

Uddin, M., & Ahmmmed, M. (2018). Islamic banking and green banking for sustainable development: Evidence from Bangladesh. *Al-Iqtishad Journal of Islamic Economics*, 10(1), 97–114. doi:10.15408/aiq.v10i1.4563

Vijay & Natarajan. (2015). *Customer's awareness towards green banking products of the select commercial banks in Cuddalore district: An Empirical Assessment*. Academic Press.

Wessels, L., & Drennan, J. (2010). An investigation of consumer acceptance of Mbanking. *International Journal of Bank Marketing*, 28(7), 547–568. doi:10.1108/02652321011085194

Zeithaml, V. A., Bitner, M., Gremler, D., & Pandit, A. (2013). *Services Marketing: Integrating customer focus across the firms* (6th ed.). Tata McGraw Hill Education Private Limited.

Chapter 7

The Impact of Climate Change on Human Resource Management in the Global Economy

Sthokozile Mamba

University of KwaZulu-Natal, South Africa

Andrisha Beharry Ramraj

University of KwaZulu-Natal, South Africa

ABSTRACT

Climate change has a global impact on everyone in their homes and workplaces. It occurs naturally but is also human-induced. It does more bad than good, especially in the workplace of every industry. Human resource functions play a major role in addressing this issue with management structures, employees, customers, and other stakeholders. The effort of reducing climate change is not an easy task, as many still have no belief that it is actually occurring. This chapter seeks to define the human resource function and climate change concept within a global economy.

INTRODUCTION

Climate change has an impact on everyone. The way in which global warming is dealt with is largely dependent on an individual and collectively as well. The response of the corporate world has a huge impact on the path that humanity chooses. It represents a large influence on whether people make climate change better or worse. With this being the case, human resource professionals are faced with challenges of how to address one of the greatest threats of this age. They are the ones responsible for shaping and maintaining the culture of an organisation (Delery & Roumpi, 2017). Some organisations in the corporate sphere continue boosting the bottom line at the expense of the environment and have no genuine determination of abandoning policies that promote that behaviour. This is due to the inability

DOI: 10.4018/978-1-7998-7967-1.ch007

to govern innocently. Those who have environmental awareness often find themselves engaging in what will compromise the environment that they are yearning to preserve (Michael, 2019).

The change of the climate has a hand in shaping the global economy. The rise of global temperature comes with the rise of operational costs which can hinder global economic growth. In a predicted worst case scenario where the Gross Domestic Product (GDP) growth per year had a reduction of one percent, this suggests that the effects will be damaging in a disproportionate manner to economies that are developing (Oluwaseyi, 2018). The climate change long-term financial repercussions can be potentially made better through a collective effort to enact carbon emissions policies that are strict. Implementing these mitigation policies can reduce the climate change sources. The remaining consequences can be dealt with through adaptation policies (Kompas, Pham & Che, 2018). The worst risks and impacts can be avoided and the climate change economic consequences can be reduced through these policies. It is expected that by the year 2060, there would be a major loss of the annual GDP unleashed from 0.9 percent to 0.8 percent if the issue of climate change is continuously ignored (Carleton & Hsiang, 2016).

For human resources to assist in redefining business practices, there has to be an understanding of the root of the problem. This can be done by understanding the market and environment and how they are treated as social goods. There will be occasional competition between their respective interests. In cases where one has to be compromised, the market is often favoured (Shamim, Cang, Yu & Li, 2016). As a result, organisations are confronted with a situation of having as much of a duty to the planet as they do to shareholders and employers. This gives rise to a very delicate act of balance. With the new generations coming to the workplace with personal values that favour the environment, there is still a possibility for making a difference (Markoulli, Lee, Byington & Felps, 2017). However, it can be challenging to redefine successful business practices that make ecological degradation worse. Organisations are more accepting of the idea to support environmental causes where a business case or gain is involved (Kianto, Sáenz & Aramburu, 2017).

It is a very long journey to get organisations to be truly sustainable, however, people being aware of this should not raise hopelessness. Instead, the importance, urgency and scale of the task should be made clear. This chapter seeks to define the role of human resources in an organisation and the concept of climate change. Furthermore, it will discuss how human resources can play a role in reducing climate change by activities that an organisation can engage their employees in. The world continues to be more industrialised and advanced. These advancements come with more machinery and activities that degrade the environment. Every organisation seeks easier ways to be more productive and to improve performance. This is done through hiring the best employees in an organisation and having equipment that makes performing tasks easier. The role of managing these resources is associated with the human resource department in organisations. However, the advancements in organisations can cause harm to the environment and in return harm people (Brewster, 2017).

GLOBAL CLIMATE CHANGE

There are numerous impacts that come with climate change. One of those impacts is that the global rise of sea levels, which is estimated at 3.6 millimeters per year, will force a large number of people out of their homes in the following decades. People residing on the coast will be mostly affected by this. Those that are in regions near the equator will suffer the consequences of unbearable heat levels (Delery & Roumpi, 2017). However, organisations have not prepared enough for how climate change

The Impact of Climate Change on Human Resource Management in the Global Economy

can affect the workforce. The assessment on climate impact has been taken by a very few number of organisations. Addressing the climate change issue in the workplace needs to be done through figuring out ways to build leadership and capacity. The impacts of climate change are already being extensively felt by some regions (Markoulli et al., 2017). For example, most organisations in Florida, United States, faced a shortage of employees in the year 2018 after being hit by Hurricane Michael which was one of the most powerful hurricanes ever experienced. These organisations such as H.G. Harders and Son, a heavy civil and marine construction organisation that has been in operation since the year 1952, still had difficulties in finding people to join their workforce a year after the hurricane. The most destructive and deadliest wildfire in Paradise, California, caused extensive damage to the Feather River Hospital which led to it being shut down in the year 2018 (Chams & García-Blandón, 2019). This hospital was one of the 18 700 structures destroyed in these wildfires. The financial losses of the hospital amounted to 38 million dollars in property and 63.5 million dollars in assets of the hospital. The 5.6 percent annual revenues of Adventist Health were accounted for by the hospital and could not be met in the year 2018 due to these fires.

Natural disasters similar to the ones mentioned above are predicted to become more common and severe. The location of organisational operations in the future is becoming highly influenced by these challenges. The unemployment rate in developing countries has been an issue (Shamim et al., 2016) and the challenges such as flooding and burning of workplaces leading to them shutting down also contributes to collapsing the economy in that region. Not only does this result in employees being retrenched but customers are also abandoned (Mousa & Othman, 2020). The global financial losses due to flooding and storms amounted to 121.6 billion dollars in the year 2011. The United Nations further mentions that natural disasters in that year totaled a global financial loss of 380 billion dollars.

Some organisations that are situated in danger zones struggle to find employees since people fear working in a hazardous area. Shrinkage of the workforce can have an impact on the economy. Organisations need to assess their preparedness for climate change and their assets, for instance, the workplace may not be affected but the ability of the employee to get to the workplace can be impacted. The transportation of goods by the organisation can also be affected (Ren, Tang & Jackson, 2018). Michael (2019) has suggested that performance goals and job descriptions include the knowledge of climate change and the potential impacts it has. Every organisation in every industry in every region of a country needs climate change preparedness so that they are not caught unprepared.

HUMAN RESOURCE MANAGEMENT

Human resource management is the process of hiring, training and compensating people. Developing policies that relate to employees and strategies to retain them is also part of the process. Human resource management has become a vital part of an organisation as it has been changing over the years. In the past, it was more of an administrative role of an organisation rather than a strategic role which was important for the success of an organisation. A role of every manager in an organisation is related to human resources even if they do not work in the human resource department (Shamim et al., 2016).

The functions of human resources can be carried out by managers in other departments. Staffing is one of the major tasks in human resources since the organisation has tasks that need to be performed by people. With the fourth industrial age underway, the organisation still needs humans to operate complex machinery that is slowly entering the workplace (Michael, 2019). Another transformation that is

occurring gradually is environmental degradation. These changes along with many others have brought changes in human resources, one being developing a staffing plan. This has to be done based on the expectations of revenue (Stahl, Brewster, Collings & Hajro, 2020). Developing policies that encourage multiple demographics beyond the normal ones is also part of adjusting staffing. This is important since people that are entering the workplace are those not afraid to embrace who they really are and look to work for organisations that align with who they are. For instance, new generations in workplaces are more open about their sexuality (Markoulli et al., 2017). Recruiting is another important aspect that can be adjusted due to new job roles that come with external changes. Selecting suitable people to fill new and old positions is key to assisting in the success of an organisation (Tang, Chen, Jiang, Paille & Jia, 2018).

Continuity and fairness in an organisation is achieved through policies. These policies can be about ethics, the discipline process, dress code and vacation time or internet usage. In most cases, human resource professionals recognise the need for a policy or the change of one, put it together, ask opinions around it and communicate it to employees. This process shows that departments of human resource in organisations cannot work in isolation (Kianto, Sáenz & Aramburu, 2017). Another task that human resources is in charge of is employee compensation. This department has to make sure that the compensation for employees meets the industry standards, is fair and is high enough to attract potential employees. Compensation takes into account the qualifications, experience and any other similar aspects of the employee. It can be in the form of health benefits, payment, sick leave, retirement plans, bonuses, vacation periods and reimbursement of tuition (Delery & Roumpi, 2017).

The act of motivating and keeping employees in the organisation is part of human resources and is known as retention. Compensation is a huge factor in this act, however there are other factors such as the relationship an employee has with the employer and their colleagues, the challenges around the job that they perform, the way they fit in with culture of the organisation and the workplace environment (Shamim et al., 2016). Another task that human resources is concerned with is the training and development of employees. When employees are hired, they are not only trained for their jobs but need to be constantly grown and developed with new skills in the job they do. Training and development forms another part of employee motivation. The feeling of being developed often makes employees happy which results in them performing well and looking forward to working and increases employee retention. Training can be that of legal and policy, communication, job skills and team building (Chams & García-Blandón, 2019).

There are certain laws, especially those regarding employment, which human resources must always be aware of as they affect the workplace. These laws include but are not limited to health-care requirements, worker safety, discrimination, compensation and labour laws (Kianto, Sáenz & Aramburu, 2017). Laws are often adjusted when there are new developments and human resource needs to make sure that this is communicated to the organisation at all times. Furthermore, employee protection and safety is another huge consideration in various workplaces (Michael, 2019). New laws are often created to reach the worker safety goal. Unions also often have an influence in the worker safety requirements of a workplace. It is the duty of human resource professionals to be aware of this and make sure that the standards of unions are met. Worker protection includes ventilation and heating requirements, chemical hazards, employee information and restriction zones such as no smoking (Shamim et al., 2016).

A general manager has to have good management and communication skills. The management of external factors is also important and human resource professionals always need to be aware of external factors that could affect the organisation. The organisation does not have a direct control over these factors but these can negatively or positively influence human resources (Markoulli et al., 2017). These factors include employment laws, globalisation, downsizing, technology, employee expectations, social

networks, workforce diversification, highly educated workforce and changing demographics in the workforce. Other trends such as telecommuting, which is allowing workers to work in a remote area, and that of flexible work schedules where workers are allowed to construct their own schedules that suit them, are other factors (Brewster, 2017). Another factor is that of climate change which is discussed below. The awareness of these factors allows human resource professionals to develop policies that will benefit employees as well as the organisation.

CLIMATE CHANGE

Climate change is not a new occurrence, it has always happened, according to geological records. Climate change is the change of the general weather patterns over a certain geographical region. This can be seen in the change of temperature or rain patterns in different seasons in an area. The industrial revolution had a hand in the increase of greenhouse gases in the atmosphere. This led to increased surface temperatures resulting from the retention of heat (Shen & Zhang, 2019). Climate change also gave rise to changes in land-use such as deforestation which affects the amount of sunlight that is reflected from the ground. Signs of climate change include droughts, tropical storms, warmer ocean water, melting ice caps and increased global temperature (Crichton, Walker & Patel, 2018).

Climate change is due to human-induced and natural factors. Some of the natural factors include carbon dioxide from most animals and their waste products. The human-induced ones are primarily from energy production through burning natural gas, oil and coal for the production of electricity. The increase of intensive agriculture, which emits nitrous oxide and methane, is also another factor (Westerman, Rao, Vanka & Gupta, 2020). Industrialisation is also a contributing factor especially in workplaces. However, the workplaces are also affected by the changes in the climate and are slowly realising that they need to save the planet so that the planet can save them (Shen & Zhang, 2019).

Every organisation has a responsibility to participate in the reduction of climate change. Practices of how to be environmentally friendly in a workplace can influence employees to take action outside the workplace such as in their homes (Nda, Adnan, Ahmad, Usman, Razi & Daud, 2018). Small acts such as not littering, recycling and switching off electric appliances when not in use can make a huge difference. Some organisations have an environmental or professional department and others have this entity included in their human resource department so that it is part of their training, compensation, policies and the objectives of the organisation (Stahl et al., 2020). Pollution of the environment is mostly due to economic industries. This is visible where in the year 2018 China had the highest emissions of carbon dioxide. When the country declared a national disaster and entered lockdown due to Covid-19 in 2020, the rate of pollution decreased by 10.8 percent (Westerman et al., 2020).

Table 1 above ranks the countries that had the highest particulate matter concentration of two and a half microns or less in their air in the year 2020. On a global scale, Bangladesh was the most polluted country followed by Pakistan which is one of the most populated countries. The pollution in these countries was mainly caused by industries and human activities. The air pollution has increased respiratory diseases. Small countries with low GDP per capita such as Mongolia are also part of the most polluting countries as are those which have a high GDP per capita such as Qatar, another small country. Some countries that experience cold weather overcome that by burning coal which contributes to the issue. Overpopulated countries such as India and China are also part of the most polluting nations. There are more industrial activities that come with the pressure on food companies, water sources and industries

in these countries due to the population causing a strain on the usage of resources. The large population also means a huge release of waste products into the environment (Rinkesh, 2021).

Table 1. Most polluted countries in 2020 according to IQAir using the average concentration of particulate matter that is 2.5 microns or less in the air

Country	Average concentration of PM _{2.5} (µg/m ³)	Life expectancy in 2020 (years)	GDP per capita in 2020 (USD)
Pakistan	101	67	1 130
Qatar	92	80	61 650
Afghanistan	84	65	565
Bangladesh	79	73	4 739
Iran	76	78	6 500
Egypt	74	72	2 900
Mongolia	64	70	4 584
Iraq	62	71	5 350
United Arab Emirates	61	78	31 947
Kuwait	61	75	30 000
India	59	70	1 877
Bahrain	57	77	20 500
Nepal	51	71	3 585
Uzbekistan	41.2	72	1 763
China	39.12	77	8 130
Bosnia & Herzegovina	35.12	77	16 063
Indonesia	28.57	72	4 038

Data source: <https://www.conserve-energy-future.com/top-most-polluted-countries-world.php>; [macrotrends.net](https://www.macrotrends.net); [tradingeconomics.com](https://www.tradingeconomics.com)

Countries such as Bahrain have a very small population and a powerful GDP per capita but still managed to make it into the group of the most polluting nations. This is due to the country experiencing industrialisation on a large scale, resulting in high carbon emissions (Rodríguez-Urrego & Rodríguez-Urrego, 2020). While the pollution of these countries is due to industrialisation, pollution in other countries such as Nepal is due to the increasing usage of outdated vehicles. There is a fear that the pollution in Nepal in particular will affect the beauty of the Himalayas. Pollution can be war-induced, such as in Iraq, however the issue in the country is also caused by gas and oil refineries. Some of the richest countries in the world, such as the United Arab Emirates with one of the smallest populations but yet very high GDP per capita, also contribute largely to air pollution. The pollution in this country is heightened by the release of nitrogen oxide, a harmful gas, into the air during the excavation of oil (Rinkesh, 2021).

Seasonal variations in pollution also occur due to dust storms. This is mostly experienced in Kuwait. This shows that pollution is not only human-induced. The most polluted country in Africa is Egypt and is becoming one of the most populated countries on the continent. Countries that are considered to be luxury, such as Qatar, contribute to the pollution of air through the usage of private cars and air traffic. Air pollution in the countries mentioned above causes health challenges which lead to a lowered life

expectancy. However, the countries that are mentioned to have a high GDP per capita did not experience a lowered life expectancy due to the easy affordability of health care systems that are of a high standard. Those with a low GDP per capita still have a continuous lowering of life expectancy (Rahman, Rana & Khanam, 2020). There has always been a need to tackle the issue of pollution. Some of the strategies include policies such as monetary ones explained below. Most strategies should be formed according to the socio-economic standards that are unique to each country. Strategies should not be formed with a “one size fits all” approach since each nation has unique challenges that contribute to the larger global issue.

Reporters have continuously given a record of the degree of pollution in different nations and urban communities on a global scale. As indicated by the World Health Organization (WHO), for example, the pollution of some countries is so severe to the extent that it can irritate the throat after a simple thirty minutes of touring. This shows exactly how destructive the pollution issue is, and to exacerbate the situation, high polluting countries are typically viewed as unsightly and never popular. As such, pollution might be a vital part of life since it cannot be totally evaded as long as there is running of power plants, petroleum derivative combustion, forest fires and modern processes, just to specify a couple (Rinkesh, 2021).

Climate change has been shown to affect many aspects of life from the economic state of a country to the health of its citizens. The table above shows the most polluting countries. For each of these countries, it shows the life expectancy and the GDP per capita. The countries with the highest GDP per capita, such as Qatar and the United Arab Emirates, had the highest life expectancy. The ones with a low GDP, such as Pakistan and Afghanistan, had the lowest life expectancy in 2020. All these countries are the most polluting in the world. As mentioned above, pollution leads to health challenges and most of the people that are affected are the working class. However, in some countries, people cannot afford medical care that is of a high standard due to low wages or salaries. Therefore, some workers have a possibility of facing mortality due to the harmful substances produced in their workplaces, as the above mentions what each country is famously known to operate in. A part of human resources in the workplace is responsible for the well-being of employees. The organisations operating in harmful industries can consider increasing wages or salaries of elder workforce as they are more vulnerable to harmful substances and need more medical care. Organisational medical aids or life policies should also be considered for people that are at high risk. An early retirement age for highly polluting industries in these countries should also be set. People are the largest assets of an organisation and should be well taken care of to increase the performance of an organisation. These suggestions do not in any way reduce climate change, but human health is as important as reducing climate change. Suggestions on how human resources can cope and reduce climate change will be mentioned in the following sections of this chapter.

HUMAN RESOURCE POSSIBLE ACTIONS TO COPE WITH AND REDUCE CLIMATE CHANGE

There are monumental changes and huge predictions about the future of work and human resources. These changes include job reductions due to artificial intelligence (AI). Considerations and plans need to be put in place for the future of human resources. These plans should also consider other contributing factors such as the changes that come with the fourth industrial age and climate change (Markoulli et al., 2017). Some advanced organisations are currently considering nanotechnology protected work clothing and uniforms which shed dirt and moisture. There is also smart clothing, which alerts employers

on whether the employees are wearing their safety equipment correctly. In the health aspect of human resources, precautions such as compulsory sun protection factor (SPF) protection for employees will also need to be considered. Making sure that employees have the right tools to be productive includes ensuring that their welfare is well taken care of when working (Chams & García-Blandón, 2019).

Organisations need to realise that they are the cause of and the cure for climate change. Some human resource departments in certain organisations still do not see this as an issue they need to tackle. This is especially when an organisation has a sustainability team. Some organisations do not see the human resource link to the climate change issue (Kianto, Sáenz & Aramburu, 2017). However, tackling climate change issues is about the future of the people so human resources staff need to feel a sense of ownership as change makers. For human resources to take ownership, organisations have to go through their objectives and business models for the future. These would have to align with the changes as much as they do with what the organisation stands for. Each employee in the organisation should adopt targets of specific areas that support circular economy such as carbon, energy consumption, waste and travel (Tang et al., 2018). They then should be expected to show they have contributed to these targets. It is more feasible for this to be adopted by employees rather than managers or executive members due to these challenges having a time frame that is different to commercial ones. Most executive members are in place for a period of around five years and therefore have many tasks to fulfill (Zaid, Jaaron & Bon, 2018).

The role of human resources in sustainability involves policies, employee objectives, values, vision and purpose. Some organisations have employees that set out to resign if the organisation they work for does not take action regarding climate change. This poses a threat where the organisation could lose valuable employees (Ren, Tang & Jackson, 2018). On the other hand, some office workers refuse to work for an organisation with a poor sustainability record. Working for an environmentally-friendly organisation has become a huge factor in the decision-making of employees. This influences the hiring strategies of an organisation. Some organisations that look to become employees of choice have transitioned to low-carbon economies and make it a point to live up to expectations (Mousa & Othman, 2020).

These expectations can be considered as small by some people such as printing policies, installation of LED light bulbs in the workplace, more efficient lighting and heating and providing reusable water bottles for employees. The operation of vegetarian-only workplaces is becoming popular. This is where employees are not allowed to bring animal products into the workplace and this includes clothing such as real fur and leather. Other organisations go to an extent of providing free vegetarian lunches for employees on certain days of the week (Tang et al., 2018). However, this is a huge shift around dietary choices and is not for everyone. Therefore, enforcing practical measures is more reasonable such as requiring employees to use recycling bins at the workplace. This also encourages change of behaviour in other employees. This is a challenge for most organisations due to the sustainability agendas of employees falling off between work and their homes (Ren, Tang & Jackson, 2018).

Human resources needs to encourage employees to have the same work behaviours at home and work. Making these targets into a lifestyle makes it easier to achieve employee and organisational goals. These kinds of behaviours can be encouraged by engaging, monitoring, tracking and rewarding employees for achieving set standards, sustainability goals or milestones. Including sustainability commitments into the annual objectives of every employee in the organisation can be beneficial (Guest, 2017). Above key performance indicators and bonuses, sustainability awards for employees involved in green initiatives can also be encouraging. This can lead to employees scoring huge contracts and partnerships for the organisation (Crichton, Walker & Patel, 2018). Sustainability has to be linked to other areas of human resources such as employee well-being. By delivering more for employees such as an energy-efficient,

high-performing and well-insulated building which has an effect on workforce health and productivity makes employees deliver more for the organisation. This is why sustainability plans are more effective when they are linked to the success of the organisation instead of it standing alone (Zaid, Jaaron & Bon, 2018).

Another way of driving sustainability engagement is through employees volunteering in environmental causes. Some organisations offer a certain amount of annual paid days off work where employees volunteer in environment-based projects (Nda et al., 2018). Employees also feel that they have larger impacts than their core roles at the workplace when participating in such initiatives. Suggestion boxes can also be another way of improving going green internally. This achieves balance in communication between employers and employees. Responsible employers give employees an opportunity to bring forward their ideas (Yong, Yusliza, Ramayah, Chiappetta, Jabbour, Sehnem & Mani, 2020). Employees should also be offered sustainability training and additional information. To contribute towards the sustainability goal, some employees opt for cycling to work instead of driving their cars and some organisations offer a carbon allowance to employees instead of a financial allowance for their travel expenses policies. Other advanced organisations are beginning to consider company cars that are electric instead of diesel or petrol alternatives. Incentives such as carpooling and rewarding employees with financial benefits or prioritised parking for using carbon free vehicles is another way of thanking employees for assisting in achieving the corporate social responsibility goal of the organisation (Mousa & Othman, 2020). Human resources is also responsible for selling the benefits for initiatives like this to employees in a language or manner that all employees will understand. Reducing the number of working days can mean that there is a day where electric power is not used at the workplace. This can be done in an organisation that can afford being flexible and remote (Tang et al., 2018).

There can be skills implications in this rapidly emerging green economy. This can mean training employees to perform their duties in a manner that is more environmentally responsible. Some progressive organisations have the concept of green learning and development in their radar. Emerging sustainability into human resources for training purposes can also equip employees in supporting customers with their sustainability goals (Guest, 2017). Human resources should also be prepared for the creation of new jobs and new industries such as that of a sustainability officer and renewables sector respectively. The skills pathways need to be mapped by human resources since some new business entities may require huge adjustments in people strategies. The adjustments can have challenges such as that the transition to a carbon-free economy could mean that some jobs will not exist in the future. Retaining and transitioning people into jobs for the future should be a fair process for all involved (Chams & García-Blandón, 2019).

IMPLICATIONS OF CLIMATE CHANGE IN HUMAN RESOURCES

Involving climate change into human resources has direct and indirect implications. There are jobs that rely on the service which the ecosystem provides such as those in tourism, fisheries, agriculture and forestry. The provision of many vital services, such as biodiversity, fresh water, stock renewal and storm protection, are threatened by climate change. This negatively affects the jobs and economic activities that rely on them. The negative effects also include the reduction in labour productivity (Zaid, Jaaron & Bon, 2018). Good working conditions for employees depend on the environmental stability maintenance and the absence of environmental changes such as air, land and water pollution and storms. Climate change is often known to change rainfall patterns and temperatures. This can lead to climate induced migration

of employees which can potentially affect the productivity of the organisation. The vulnerable workers are the ones who tend to be affected the most by the degradation of the environment. These workers are usually those living in poverty, foreigners, women, the disabled and other disadvantaged groups, depending on the region or country (Yong et al., 2020). This generates and increases inequality. The provision of working conditions that are decent, safe and healthy is reliant on the absence of environmental hazards. The environmental damage results most from industrial incidences which are human-induced. It is projected that heat stress will be made more common by the increase of temperatures and this will result in an average of 1.9 percent reduction of work hours in the G20 (Group of Twenty) countries, which South Africa is also part of, by the year 2030 (Mousa & Othman, 2020).

The above results from the workplace that come with climate change suggests that there has to be changes in training programmes. Workers have to be trained in a way that will be suitable to deal with the changing environmental conditions. Training for new jobs that will come with the change of the environment needs to be developed (Guest, 2017). Reskilling and upskilling of employees should also be done since there are already employees losing jobs due to organisations changing their operations which were not going to be productive under the environmental changes occurring. The training provided therefore helps in skills acquisition, which is necessary for further interrelated aspects in the changing skill (Beharry-Ramraj & Amolo, 2020). The human resources department also needs to develop these new jobs and positions in the organisation. These environmental conditions affect the workplace conditions in some organisations (Zaid, Jaaron & Bon, 2018). Therefore, the employee safety and health policies in organisations have to be adjusted to cater for any implications that can result from workers working in an environment that is degrading. There is also more attention that would need to be focused on employee well-being. In some sectors, the employees that are not environmentally compatible would lose their jobs such as the old aged working on farms where they are exposed to extreme heat with their high blood pressure or any other medical conditions. The recruitment requirements could also need to be adjusted to attract suitable workers (Yong et al., 2020).

MONETARY POLICY RESPONSES TO CLIMATE CHANGE

A collective effort to respond to climate change is needed from firms, governments, individuals, and shareholders so that measures to mitigate the effects are adapted and implemented. The main culprit causing global warming is carbon dioxide emissions. The reduction of emissions must be effectively targeted by these policy responses. A realignment of resource allocation is required through government intervention since the negative externality due to global warming is not priced and incorporated by free markets. Economic costs can be catastrophic if public policy does not change the behaviour of the private sector (Dafermos, Nikolaidi & Galanis, 2018). Not changing the behaviour can lead to the risk of economies continuing to pollute the environment to a point where it is too late to recover the costs. Climate change can be effectively tackled by intergovernmental agreements which enclose all the major economies. The reduction of carbon dioxide emissions could fall short of what is actually needed to make a global level material impact if there is only an effort of a handful of countries involved without a collective policy response from every country (Tol, 2018).

The risks of climate change can be reduced by a rapid energy transition to decarbonise the energy supply of the world. The measures of energy efficiency can reduce demand and speed up the decarbonisation by using hydrogen, biofuels and clean energy. The cost of energy can be reduced and innovation

The Impact of Climate Change on Human Resource Management in the Global Economy

can be promoted through governments offering subsidies to the providers of green energy (Oluwaseyi, 2018). The financial system risks that would occur if regulations of climate were to limit the increase of global temperatures are to be researched by the Bank of England. This was a result of a comment made by Mark Carney at the World Bank seminar in the year 2014 which suggested the possibility of proven reserves of gas, oil and coal to be regarded as unburnable if there is a two degrees celsius increase in regulation limited temperature (Kahn, Mohaddes, Pesaran, Raissi & Yang, 2019).

Economists suggest that a globally recognised approach that is market-based is required to stem the production of carbon dioxide in an effective manner. Therefore, carbon pricing has been a widely proposed measure. This effective measure to combat climate change includes the distribution of tradable permits which license a stated level of carbon emissions or the placement of a price on each tonne of carbon dioxide that has been emitted. In an economic state, this ensures that organisations which emit carbon dioxide pay for the social costs that are associated with fossil fuels being burnt (Kompas, Pham & Che, 2018). However, this proposal brings up questions that are primarily concerned with determining the appropriate levels of emission, implementation measures and pricing. A global recognition is needed for this to be a success. By the year 2030, a suggested 100 dollars per tonne of carbon dioxide is estimated to be needed. However, there are only a few countries that are willing to introduce carbon pricing and make their economies uncompetitive on an international level (Dafermos, Nikolaidi & Galanis, 2018).

Another method to fight climate change is where shareholders are faced with the responsibility to initiate the change. This can be done through the voting rights that shareholders have in making emphasis on ensuring that long-term goals are met. One of these goals can be that of reducing carbon dioxide emissions. There would be a measurement and remuneration for directors of fossil fuel organisations for meeting the set goals. A plan like this can have capital expenditure redirected away from the exploration of fossil fuels and directed to the development of projects of clean energy (Kahn et al., 2019). However, this method relies on emission ceilings that are low or carbon pricings that are high for it to be a success and to have an economically viable transition (Michael, 2019).

There are implications that accompany these policies. Higher inflation will be created and economic growth will be reduced by climate change. This will place central banks of the world in a situation where the growth of the economy will need to be stimulated in a case where economic growth is weak, but this can aggravate inflation (Tol, 2018). However, there is a great threat to these mitigation mechanisms. Corruption stands as a great barrier to effective environmental sustainability. The risks of climate change corruption are high due to the level of uncertainty, complexity and the novelty surrounding the issues of climate (Kahn et al., 2019). Therefore, close attention needs to be paid to how the finances of climate are administered and utilised for the sake of accountability and transparency between countries. This has to be done in both developing and developed countries. It is required more especially in developing countries where corrupt practices are prevalent with financial aid that is not concerned with the climate but with poverty and other social issues (Oluwaseyi, 2018).

FINANCIAL IMPLICATIONS ON HUMAN RESOURCE MANAGEMENT DUE TO CLIMATE CHANGE

Studies on the direct financial impact of climate change on human resource development are limited. Therefore this section will look at the implications of climate change on the global economy and then view the effect of the state of the economy on human resource management and strategies proposed.

The studies widely available on climate change impacts on the global economy state that the estimated annual temperature increases of 1.5 degrees celsius are predicted to lead to global GDP losses of 0.2 to 2 percent per year. This negative economic growth is mostly projected for countries that are in the southern hemisphere and those around the equator even though the annual average growth rate of global warming is near indistinguishable from the current conditions of the climate (Carleton & Hsiang, 2016). The statistical analysis of global temperatures and the outcomes of the economy by Burke, Hsiang and Miguel (2015) using a historic dataset estimated that the average global GDP per capita could be reduced by 23 percent by the year 2100. This translates to a decreasing annual global GDP growth rate by 0.28 percent with most of the reductions being concentrated in poor countries.

Further studies estimated that the net present value of global economic damage caused by climate change to be 54 trillion dollars and 69 trillion dollars at the 1.5 degrees celsius and two degrees celsius increasing in warming respectively, from the year 1961 to 1990 (Kompas, Pham & Che, 2018). Furthermore, negative economic impacts such as these ones are predicted to be disproportionately experienced by developing countries especially those in Africa, Latin America and Southeast Asia. The countries that are considered as rich could also be impacted but the poor ones are vulnerable. An estimation of an additional 122 million people could be experiencing extreme poverty in the year 2030 due to declining health and increased food prices. This shows that climate change does not only threaten economic growth but the livelihoods of people (Carleton & Hsiang, 2016).

Threatened economic growth impacts a variety of sectors. One of these sectors is the human resource development. Changing economic situations have always had an effect on the development of human resources. The decrease in economic growth causes organisations to decrease or freeze their annual human resource budget in areas such as training and development, utilisation of external consultants, external training, recruitment and human resource systems (Lee & Lee, 2018). This affects the performance of the organisation as it is believed that human resources has a huge influence on performance. Due to these financial challenges, most organisations change their human resource strategies. Some human resource professionals state that this causes a balance shift between the tactical or operational and strategic human resource work (Wilenius, 2017). It is argued that organisations are forced to have a thorough examination of performance due to possible global recession. However, the debate on whether the focus of human resource development is on organisational learning or organisational performance is ongoing. Despite this, the ultimate question on whether human resource development can make a meaningful contribution to the success of an organisation in the sector or market they are in still remains (Meyer & Xin, 2018).

The major human resource challenge that comes with a decrease in economic growth is retrenchments, downsizing and layoffs. The other human resource management challenges due to climate change were mentioned above. The researcher found no direct links between the financial losses of human resource development due to climate change. However, human resources has proposed strategies to reduce the effects of the economic crisis, which could be due to any incident, including climate change. These strategies include outsourcing workers to complete certain tasks to avoid mass retrenchment. Doing 'gigs' for organisations is becoming more common where organisations hire an individual for a certain task that they have skills for (Kose & Ohnsorge, 2019). The creation of new job functions is another strategy where job functions should be more important than job creation and not hiring for the sake of just hiring (Wilenius, 2017). Another strategy is reviewing the organisational procedures and structure to improve the process of decision-making and set shared visions. Government involvement is another strategy that is vital since an organisation can use external assistance and could assist those external to the organisation (Lee & Lee, 2018).

DISCUSSION

Climate change does not only have an impact on the environment, but it also affects humans. It is essential to limit the magnitude of climate change by combating it as a global environmental change. The effects of climate change are already felt by the planet. It is also causing shifts that are irreversible in the way that work is done and the kind of skills needed by employers (Shamim et al., 2016). Everything from health to finance has been shaken by climate change. All industries are likely to be affected by environmental changes and many professions such as farmers, engineers, financial planners and doctors will have to shift their framework for future plans. Employees need to be concerned with what climate change means for their careers, the same way they are concerned by the new industrial revolution (Chams & García-Blandón, 2019).

The need for understanding climate change in business should be similar to that of understanding how to use a computer a few years ago. This is especially important in a business world where globalisation is becoming more common and a disruption in a single place can result in consequences in other regions. This was seen in the production suspension at Toyota in the year 2016 when Japan earthquakes damaged their plants (Michael, 2019).

Warmer weather patterns can also exacerbate diseases such as dengue and malaria in vulnerable areas. These changes can also spread diseases in a faster way than before. This can put a strain on the health sector and also result in employee shortage when they get affected or infected (Guest, 2017). The Covid-19 pandemic has shown the amount of disruption a disease can cause in a workplace in a very short period of time. Organisations that were not well prepared had the most negative impacts and economies suffered (Stahl et al., 2020). Many organisations are failing to mitigate and adapt to climate change. Very few employees are trained to incorporate climate change in their plans for the future. Some human resource professionals do not have the right people that have the right skills in the right places to run training programmes on environment-related skills. Most organisations look for tech skills the most due to the way technology has been incorporated and is changing the workplace (Zaid, Jaaron & Bon, 2018). Climate change is a gradual change as the industry changes. Environmental skills need to start being in demand as that of technology. However, most organisations are chasing profit and the demand for these skills would depend on how they will benefit the organisation. There has, however, been an increased attractiveness of jobs in the green economy (Brewster, 2017).

Some employees from sectors such as energy are equipping themselves with skills that are transferable to issues that are environmental-change specific. On the other hand, climate change is like any other destructive phenomena such as politics, technology and others which do not necessarily require a different set of skills to deal with issues that they bring about (Tang et al., 2018). The generation of millennials usually considers whether the values of the organisation aligns with their personal ones. They also take into account the environmental and social commitments of an organisation when weighing up a job offer from a desired organisation. This generation is the future of many workplaces since they have most of the latest in-demand skills to give an organisation a competitive advantage (Yong et al., 2020).

There is still poor documentation of the mechanisms of climate change on the health of workers and the general population. However, there are consequences of working in hot conditions that have been identified. These consequences include heat strokes, dehydration and discomfort. There are also indirect impacts such as pollen and infectious diseases, inhalation of substances that are volatile and impaired alertness (Stahl et al., 2020). The change in the environment can alter the range of vectors such as mosquitoes and ticks or new vectors can be promoted by it. Workers that work with the environment or animals

can be at risk due to this. The people that provide emergency responses can face mental and physical fatigue due to disasters such as increased rain, flooding, drought and fires (Mousa & Othman, 2020).

The concern for global economic health raised a corporate interest in the mitigation of climate change. Research has found that the productivity of workers affected by rising temperatures in areas that are already warm such as Africa can cost the global economy more than two trillion dollars by the year 2030. It is therefore becoming impossible to operate an organisation without discussing the climate and sustainability (Tang et al., 2018). The salaries paid to people that have climate expertise in some organisations show how seriously they take climate change and the value they put on climate-related skills. However, some organisations have not fully appreciated the economic value that climate teams can bring into a business and weigh the climate change competencies of potential employees (Ren, Tang & Jackson, 2018).

RECOMMENDATIONS

There should be no delay in strengthening action in the workplace so that the awareness of health effects brought by climate change can be promoted through training and information distribution. Human resource professionals should be encouraged to immediately start integrating climate change and human resource practices. Risk assessments related to the environment and the employees should be put in place in every organisation. Efforts that are already undertaken should be further continued to prevent any risks that may arise. Specific human resource tools need to be developed to make teaching about environmental changes easy in an organisation. The tracking and monitoring of climate change effects of human health can be done through identifying and using relevant indicators of the impacts. Environmental changes should be part of performance goals in an organisation. Organisations should also invest in creating new jobs that have more focus on how the organisation impacts the environment and how the organisations operate for the betterment of the climate. The developments between human resource management and climate change should be documented further so that trends can be formulated and actions taken. Extreme events should be anticipated in the future, so it is important for organisations to always be ahead.

Further research should be done on the health risks of employees brought about by climate change. Training techniques for new and old employees on climate change should be formulated. More research should be done regarding expected employee productivity and the influence of environmental conditions in which the workplace is situated. Researchers should also look into studying how the new industrial age in a workplace can be used to decrease environmental degradation. The human resource management of organisations can also partner with the medical sector to find ways that can benefit the health of employees in a case where climate change gets worse than expected.

FUTURE RESEARCH

More research needs to be done regarding financial impacts on human resource development due to climate change. Studies on climate change impacts should be more on a national level rather than a global level due to the different global climates that come with different impacts. This is because of the different socio-economic conditions experienced in developing and developed countries. Future research should also focus more on how human resources can collaborate with advanced technology in the field

to reduce climate change. Human resource management strategies on how to carry out the policies effectively should also be studied in more detail because individuals and organisations that contribute to global warming should be held accountable. More studies should be conducted where the impact of the global economy state on the South African economy due to climate change should be explored. Since most countries are moving towards a more technologically advanced environment, especially after the occurrence of Covid-19 which limited human interaction, and the fourth industrial revolution, the impact of technology to reduce climate change on human resource management policies in South Africa should be explored.

CHAPTER SUMMARY

Human resource management is an important part of an organisation. It is the process of managing the workforce in an organisation and is also in charge of putting together organisational policies. Most of the resources in the organisation are handled by this department. The resource of concern, which is humans, is also managed by it in terms of hiring, training, developing, retaining, compensation and their well-being. Human resource management needs to always be aware of changes that are internal and external to the organisation so that the organisation is always well prepared especially with new jobs and new skills within an industry.

Climate change is the process by which the normal weather patterns of a region are constantly shifting. These shifts can be towards more rainfall, increased heat, drought, earthquakes, hurricanes, floods and other natural disasters. Climate change is due to natural causes and is also human-induced by the constant pollution in the air, land and water. It does not only have an impact on the environment but also on the economy and human health. The countries that cause the most pollution reveal the kind of impact that climate change has on human health and the economy of the country. It has also shown the leading causes of pollution, which leads to climate change, in each country that is different from another.

Some organisations still do not believe that climate change is occurring and that there are actions they can take to reduce it or make coping with it easier. Human resource professionals as the change-makers in the organisation have tasks to implement such as introducing protective work gear for employees, reduced working hours especially in work environments directly impacted by changed climate conditions and the culture of reusing and recycling at work and at home. To prepare for the future of work in a different climate with new jobs and new skills to also suit the state of industrialisation, human resource management needs to ensure that employees in organisations are well trained and skilled and will also know how to retain the valuable staff members. Employees need to be motivated to take initiative in reducing environmental degradation. Motivation can be in the form of paid volunteering leave, awards, compensation and other incentives. The environmental aspect of the organisation should also be reflected in the core values and vision of it more than in the management tasks because management of organisations usually changes after a few years.

Since human resources is responsible for managing employees in an organisation, there are some implications that it can face regarding climate change. There will be increased employee absenteeism in industries where there is a direct impact by climate change such as farming. This is also possible for regions where weather conditions such as rainfall or heat will be too extreme for employees to make it to work. Changes in the climate also exacerbate diseases and have the potential of introducing new diseases which can make it impossible for employees to work. The disease can also be transferred to

other employees if others still work while infected. Climate change also brings about new job roles in the organisation so human resources need to find means to train and develop these workers. Other employees are beginning to refuse to work for organisations that are not environmentally friendly and human resource professionals are in a position of needing to find ways to make the organisation attractive to future employees. The employee health and safety policies also need to be adjusted.

CONCLUSION

The influence of human resources extends beyond its own organisation. For human resource leaders that are still considering putting sustainability into their agenda, the internal environment serves as a good starting point. The entire lifecycle of human resources needs to go green to assist in reducing climate change. The use of key performance indicators and sustainability targets can be effective when engaging the workforce through recruitment, learning and development, office environment, recognition and rewards and environmental networks. Human resources, like every other part of a business, can play a role in reducing climate change.

The organisations that are taking this issue seriously need to be recognised to raise awareness and influence other organisations. There is value that sustainability has in the ability to attract and retain talent, in reputation and competitiveness. Being environmentally friendly can also shape the business operations and strategies of the organisation. Being aware of the environmental, societal and economic impact that an organisation has is also important for their operations. The human resource function has a huge role to play in this. To cope with climate change in the workplace, the competencies of human resources need to be adjusted. This needs to also be done to shape the impact the organisation has on the employees, community, customers and other stakeholders.

The countries which produce the most pollution need to be challenged to take action against climate change as well. This can be done best through workplaces as they make up the organisations that make up the economy of the country and have direct contact with most of the people in the country. The complexity of climate change needs to stop being underestimated. Everyone in the organisation can play a part in tackling this issue more especially because organisations are becoming flat structured instead of hierarchical when there is a top-down decision-making manner. Most of the current workforce is made up of millennials who have more advanced ideas regarding socio-economic issues. In the words of Dave Chappelle, modern problems require modern solutions.

REFERENCES

Beharry-Ramraj, A., & Amolo, J. (2020). *Changing Skills And Attendant Stressors: Appraising The Efficacy Of Traditional Wellness Programmes In The 4IR*. Available From: <https://www.igi-global.com/chapter/changing-skills-and-attendant-stressors-appraising-the-efficacy-of-traditional-wellness-programmes-in-the-4ir/265614>

Blaum, D., Griffin, T. D., Wiley, J., & Britt, M. A. (2017). Thinking about global warming: Effect of policy-related documents and prompts on learning about causes of climate change. *Discourse Processes*, 54(4), 303–316. doi:10.1080/0163853X.2015.1136169

The Impact of Climate Change on Human Resource Management in the Global Economy

- Brewster, C. (2017). The integration of human resource management and corporate strategy. *Policy and Practice in European Human Resource Management*, 22-35.
- Burke, M., Hsiang, S. M., & Miguel, E. (2015). Global non-linear effect of temperature on economic production. *Nature*, 527(7577), 235–239. doi:10.1038/nature15725 PMID:26503051
- Carleton, T.A. & Hsiang, S. (2016). Social and economic impacts of climate. *Science*, 353(6304), 1112.
- Chams, N., & García-Blandón, J. (2019). On the importance of sustainable human resource management for the adoption of sustainable development goals. *Resources, Conservation and Recycling*, 141, 109–122. doi:10.1016/j.resconrec.2018.10.006
- Crichton, R., Walker, T., & Patel, A. (2018). Slowing climate change: Mitigating poverty and environmental degradation via strategic human resource management and responsible leadership. In *CSR and Climate Change Implications for Multinational Enterprises*. Edward Elgar Publishing. doi:10.4337/9781786437761.00010
- Dafermos, Y., Nikolaidi, M., & Galanis, G. (2018). Climate change, financial stability and monetary policy. *Ecological Economics*, 152, 219–234. doi:10.1016/j.ecolecon.2018.05.011
- Daioglou, V., Muratori, M., Lamers, P., Fujimori, S., Kitous, A., Köberle, A. C., & Mima, S. (2020). Implications of climate change mitigation strategies on international bioenergy trade. *Climatic Change*, 163(3), 1639–1658. doi:10.1007/10584-020-02877-1
- Delery, J. E., & Roumpi, D. (2017). Strategic human resource management, human capital and competitive advantage: Is the field going in circles? *Human Resource Management Journal*, 27(1), 1–21. doi:10.1111/1748-8583.12137
- Guest, D. E. (2017). Human resource management and employee well-being: Towards a new analytic framework. *Human Resource Management Journal*, 27(1), 22–38. doi:10.1111/1748-8583.12139
- Healey, N. M. (2017). *Reflections on the value of insider research as a qualitative research methodology*. SAGE Publications Ltd. doi:10.4135/9781526401489
- Hegerl, G. C., Brönnimann, S., Cowan, T., Friedman, A. R., Hawkins, E., Iles, C., & Undorf, S. (2019). Causes of climate change over the historical record. *Environmental Research Letters*, 14(12), 123006. doi:10.1088/1748-9326/ab4557
- Helms, C., Pölling, B., Curran, T., & Lorleberg, W. (2018). *Desktop research: national literature reviews and analyses of educational resources*. Academic Press.
- Kahn, M. E., Mohaddes, K., Ng, R. N., Pesaran, M. H., Raissi, M., & Yang, J. C. (2019). Long-term macroeconomic effects of climate change: A cross-country analysis (No. w26167). National Bureau of Economic Research.
- Kianto, A., Sáenz, J., & Aramburu, N. (2017). Knowledge-based human resource management practices, intellectual capital and innovation. *Journal of Business Research*, 81, 11–20. doi:10.1016/j.jbusres.2017.07.018

- Kompas, T., Pham, V. H., & Che, T. N. (2018). The effects of climate change on GDP by country and the global economic gains from complying with the Paris climate accord. *Earth's Future*, 6(8), 1153–1173. doi:10.1029/2018EF000922
- Kose, M. A., & Ohnsorge, F. (2019). *A decade after the global recession: Lessons and challenges for emerging and developing economies*. World Bank. doi:10.1596/32641
- Lamb, W. F., & Steinberger, J. K. (2017). Human well-being and climate change mitigation. *Wiley Interdisciplinary Reviews: Climate Change*, 8(6), e485. doi:10.1002/wcc.485
- Lee, J. Y., & Lee, Y. (2018). Job crafting and performance: Literature review and implications for human resource development. *Human Resource Development Review*, 17(3), 277–313. doi:10.1177/1534484318788269
- Markoulli, M. P., Lee, C. I., Byington, E., & Felps, W. A. (2017). Mapping Human Resource Management: Reviewing the field and charting future directions. *Human Resource Management Review*, 27(3), 367–396. doi:10.1016/j.hrmr.2016.10.001
- Matata, A. C. & Adan, A. (2018). *Causes of climate change and its impact in the multi sectoral areas in Africa-Need for enhanced adaptation policies*. Academic Press.
- Meyer, K. E., & Xin, K. R. (2018). Managing talent in emerging economy multinationals: Integrating strategic management and human resource management. *International Journal of Human Resource Management*, 29(11), 1827–1855. doi:10.1080/09585192.2017.1336362
- Mi, Z., Guan, D., Liu, Z., Liu, J., Vigiúé, V., Fromer, N., & Wang, Y. (2019). Cities: The core of climate change mitigation. *Journal of Cleaner Production*, 207, 582–589. doi:10.1016/j.jclepro.2018.10.034
- Michael, A. (2019). *A handbook of human resource management practice*. Academic Press.
- Mishra, P. (2017). Green human resource management: A framework for sustainable organizational development in an emerging economy. *The International Journal of Organizational Analysis*, 25(5), 762–788. doi:10.1108/IJOA-11-2016-1079
- Mousa, S. K., & Othman, M. (2020). The impact of green human resource management practices on sustainable performance in healthcare organisations: A conceptual framework. *Journal of Cleaner Production*, 243, 118595. doi:10.1016/j.jclepro.2019.118595
- Nda, M., Adnan, M. S., Ahmad, K. A., Usman, N., Razi, M. A. M., & Daud, Z. (2018). A review on the causes, effects and mitigation of climate changes on the environmental aspects. *International Journal of Integrated Engineering*, 10(4). Advance online publication. doi:10.30880/ijie.2018.10.04.027
- Oluwaseyi, O. A. (2018). Climate Change and its Effect on the Global Economy and Security: A Call for more Robust Climate Finance, Prevention of Climate Finance Against Corrupt Spending and Review of Articles 9 (1), (3) & (4) of the Paris Agreement and 12 (8) of Kyoto Protocol to the United Nations Framework Convention on Climate Change. *Environment Pollution and Climate Change.*, 02(03). Advance online publication. doi:10.4172/2573-458X.1000157
- Rahman, M., Rana, R., & Khanam, R. (2020). *Determinants of Life Expectancy in Most Polluted Countries: Exploring the Effect of Environmental Degradation*. Academic Press.


The Impact of Climate Change on Human Resource Management in the Global Economy

- Ren, S., Tang, G., & Jackson, S. E. (2018). Green human resource management research in emergence: A review and future directions. *Asia Pacific Journal of Management*, *35*(3), 769–803. doi:10.1007/10490-017-9532-1
- Rinkesh. (2021). *17 Top Most Polluted Countries in the World as of 2020*. Available from: <https://www.conserve-energy-future.com/top-most-polluted-countries-world.php>
- Rodríguez-Urrego, D., & Rodríguez-Urrego, L. (2020). Air quality during the COVID-19: PM2.5 analysis in the 50 most polluted capital cities in the world. *Environmental Pollution*, *266*, 115042. doi:10.1016/j.envpol.2020.115042 PMID:32650158
- Shamim, S., Cang, S., Yu, H., & Li, Y. (2016, July). Management approaches for Industry 4.0: A human resource management perspective. In *2016 IEEE Congress on Evolutionary Computation (CEC)* (pp. 5309-5316). IEEE. 10.1109/CEC.2016.7748365
- Shen, J., & Zhang, H. (2019). Socially responsible human resource management and employee support for external CSR: Roles of organizational CSR climate and perceived CSR directed toward employees. *Journal of Business Ethics*, *156*(3), 875–888. doi:10.1007/10551-017-3544-0
- Stahl, G. K., Brewster, C. J., Collings, D. G., & Hajro, A. (2020). Enhancing the role of human resource management in corporate sustainability and social responsibility: A multi-stakeholder, multidimensional approach to HRM. *Human Resource Management Review*, *30*(3), 100708. doi:10.1016/j.hrmr.2019.100708
- Tang, G., Chen, Y., Jiang, Y., Paille, P., & Jia, J. (2018). Green human resource management practices: Scale development and validity. *Asia Pacific Journal of Human Resources*, *56*(1), 31–55. doi:10.1111/1744-7941.12147
- Tol, R. S. (2018). The economic impacts of climate change. *Review of Environmental Economics and Policy*, *12*(1), 4–25. doi:10.1093/reep/rex027
- Westerman, J. W., Rao, M. B., Vanka, S., & Gupta, M. (2020). *Sustainable human resource management and the triple bottom line: Multi-stakeholder strategies, concepts, and engagement*. Academic Press.
- Wilenius, M. (2017). *Patterns of the future: Understanding the next wave of global change*. Academic Press.
- Yong, J. Y., Yusliza, M. Y., Ramayah, T., Chiappetta Jabbour, C. J., Sehnem, S., & Mani, V. (2020). Pathways towards sustainability in manufacturing organizations: Empirical evidence on the role of green human resource management. *Business Strategy and the Environment*, *29*(1), 212–228. doi:10.1002/bse.2359
- Zaid, A. A., Jaaron, A. A., & Bon, A. T. (2018). The impact of green human resource management and green supply chain management practices on sustainable performance: An empirical study. *Journal of Cleaner Production*, *204*, 965–979. doi:10.1016/j.jclepro.2018.09.062

Chapter 8

The Relationship Between Climate Change and Financial Stability

Joan Nyika

 <https://orcid.org/0000-0001-8300-6990>

Technical University of Kenya, Kenya

ABSTRACT

Climate change is the greatest challenge of the modern day with the capacity to destabilize global financial systems and socioeconomic welfare. This chapter explores the uncertainties posed by climate change, its effects on the economy, the risks associated with the phenomenon, and approaches to manage them through risk management. Using documented evidence, climate change is shown to result in gross domestic product reductions; physical, transition, and liability risks that result to systemic financial problems characterized by liquidation of companies, losses for, and closure of financial firms and their intermediaries; and inability of investors to pay debts. Climate risk management is proposed as a solution to adapt to climate change and reduce its associated risks.

INTRODUCTION

The disturbance in the long-term of normally perceived weather patterns resulting from global warming is commonly referred to as climate change. According to Nyika (2020), the phenomenon is a great impediment to sustainable growth globally. The situation is of great concern among developing countries since their vulnerability is high and their resilience and preparedness are limited due to financial constraints and high poverty levels (Nyika, 2021). According to the Intergovernmental Panel on Climate Change (IPCC) (2018), anthropogenic-based activities have resulted in the warming of planet earth by 1°C above the pre-industrial levels. Consequently, storms, wildfires, droughts, and floods with catastrophic consequences are becoming regular occurrences. Current projections also show that these changes will have dire economic, environmental, and social impacts. A study by Kompas, Pham and Che (2018), for instance, suggested that if temperatures rise 4°C higher compared to pre-industrial levels in the next 8

DOI: 10.4018/978-1-7998-7967-1.ch008

The Relationship Between Climate Change and Financial Stability

decades, economic losses around the globe will rise to \$ 23 trillion every year and this would result in a crisis worse than the 2007-2008 financial crises globally. The magnitude and speed at which actions are taken to reduce greenhouse gas emissions will influence how much of the impacts of climate change can be overcome in the coming decades if sustainability is to be realized.

Climate change worsens pre-existent risks in addition to creating new ones for human and natural systems (IPCC, 2014). Global risks associated with climate change are highlighted by the World Economic Forum's Global Risk Report (World Economic Forum, WEF, 2016). In specific, the lax and inability to mitigate and adapt to climate change is ranked in the top five considering that the adverse effects of the phenomenon are systemic and pervasive (Zhao, Yan, Wang, Tang, Wu, Ding & Song, 2018). Besides, they affect all economies, industries, and classes of assets and people resulting in a negative impact on the financial system.

Climate change has severe consequences on financial stability as established in the literature (Aglietta & Espagne, 2016; Batten Sowerbutts & Tanaka, 2016; Scott van Huizen & Jung, 2017; Dafermos, Nikolaidi & Galanis, 2017, 2018). Notable cases that were linked to climate change effects include the bankruptcy of Pacific Gas and Electric (PG and E), which was California's largest electricity producer. In this case, climate change resulted in consumption and production disruptions as well as a reduction of the company's asset value (MacWilliams, LaMonaca & Kobus, 2019). Similarly, the former governor of the Bank of England, Mark Carney suggested that with ample evidence on the threatening nature of climate change, the phenomenon is likely to influence financial stability in the long term (Carney, 2015).

The risks associated with climate change can be categorized into two: 1) transition risks and 2) physical risks according to Dafermos et al. (2017, 2018). Physical risks are associated with economic damages resultant from extreme climate events while transition risks focus on the reassessment of carbon-intensive items and the consequences of shifting to a greener economy with low-carbon production. The majority of existent studies have focused on transition risks (Battiston, Mandel, Monasterolo, Schütze & Visentin, 2017; Stolbova, Monasterolo & Battiston, 2018; Trinks, Scholtens, Mulder & Dam, 2018) and only limited research is done on the physical risks (Dietz, Bowen, Dixon, & Gradwell, 2016; Bovari, Giraud & Mc Isaac, 2018). Gelzinis and Steele (2019) also identify the physical and transition risks as the results of climate change. In addition to these two risk categories, the Financial Stability Board, FSB (2020) introduces the liability risk as a result of climate change. Liability risks occur once parties are held responsible for losses affiliated with environmental destruction resulting from errors of omission or their actions. These forms of risks are discussed in more in this chapter. Assessing these risks irrespective of their type is crucial since it informs on the costs, environmental and ecosystem damages of inaction to climate change over the next generations, and economic development and sustainability. According to Oguntuase (2020), assessing the uncertainties associated with climate change to explain its risks and their financial implications is important following the precognition that the phenomenon is one of the modern day's global challenges. This book chapter will explore the uncertainties of climate change in relation to the outlined risks, the economic consequences of the phenomenon, and its impacts on financial stability in an intensive examination of the literature.

SCIENTIFIC UNCERTAINTY IN RELATION TO CLIMATE CHANGE

Since the confirmation of the role of carbon dioxide (CO₂) in climate change by Arrhenius (1896), many scientific authors have agreed that the phenomenon resulting in global temperature rises is manmade

and propagated by the release of greenhouse gases (GHGs) into the atmosphere. Of the GHGs, CO₂ release is the most prevalent owing to the combustion of fossil fuels among other land use, forestry, and industrial activities though other gases such as a nitrous oxide (N₂O) and methane (CH₄) contribute to climate change (Cook, Oreskes, Doran, Anderegg, Verheggen et al., 2016). The decay of the gases results in average temperature rises as has been witnessed in the past decade compared to the last century. These consequences have been noted as disruptors of economies, societies, and ecosystems to some catastrophic levels that are difficult to recover or have irreversible consequences to the existence of humankind (Steffen, Rockstrom, Richardson, Lenton, Folke, Liverman et al., 2018; Ripple, Wolfe, Newsome, Barnard, & Moomwa, 2019). Data collected in the last 30 years that easily discern natural variability from anthropogenic activity has been able to confirm the risks of climate change based on hypothesis testing and modelling. It is from this science that the IPCC Special Report on the ocean and cryosphere has confirmed with certainty the effects of global warming such as the sea-level rise and the melting of glaciers (IPCC, 2019) to named economies.

Although the future is unknown, the risk of climate change is well documented since the probability distribution of its effects in long term is known (Oguntuase, 2020). However, when predicting these future outcomes, there is a lot of uncertainty. This uncertainty is characterised by the inability to predict how quickly the sea level will rise and how the process will occur, how forests will respond to changes in atmospheric CO₂ and precipitation patterns among other aspects of climate change. Mehta, Adam and Srivastava defined uncertainty as, “a situation characterised by indeterminacies and refers to what we cannot know for certain in terms of outcomes, effects or impacts of a particular event where the probabilities cannot be calculated” (2019, p. 1529). This uncertainty is not limited when determining the impacts of climate change but also available adaptation and mitigation options. This is because the answers to the uncertainties are complexed by the natural variability of climate and vary geographically and temporally. Evenly, the predispositions of temperatures and GHG emissions in the future also involve uncertainty and risk. It is the uncertainty involved in predicting the effects of climate change that prevent the forecasting of the exact location, time, intensity, frequency, and nature that the phenomenon will occur. Policies, preferences, values, and technology among other socioeconomic and demographic factors influence the level of uncertainty (Kalra, Hallegate, Lempert, Brown, Fozzard, Gill, et al., 2014). Limited knowledge of the climate system also worsens the apparent uncertainty during climate change risk analyses (Heal & Milner, 2013).

Due to the multifaceted nature of uncertainty sources, most studies evaluating climate change impacts rarely yield consensus in their outcomes, vulnerability levels, and exposure distribution. It is for this reason that climate change has no definitive probability density functions (Kunreuther, Heal, Allen, Edenhofer, Field & Yohe, 2012). In estimating the economic outcomes of climate change, these uncertainties are known causes of imprecision. Consequently, there is an imperfect understanding of mitigation measures to the phenomenon and also a suggestion that the current outcomes could be even worse according to Oguntuase (2020). In a similar viewpoint, Knight and Ganguly (2018) noted that if the temperature projections were worse compared to the current projection, the economic consequences of climate change could even have grave effects than currently perceived. Lewandowsky, Risbey, Smithson, Newell and Hunter (2014) on the contrary highlight the extreme notion of uncertainty where the climate change problem may be less grave compared to the anticipations of modelled results. In this notion, science is thought to exacerbate environmental issues than what they are.

Although climate change prediction is muddled with uncertainty, its results are crucial in informing on the adaptation and mitigation policies to be taken up. Additionally, it is from the modelling analysis that

The Relationship Between Climate Change and Financial Stability

governments and relevant agencies devise measures to take once the consequences of climate change have occurred. In support of this standpoint, Marotzke (2019) noted that many countries are passing national and international legislation on climate change mitigation based on modelled results. The acceptance of this measure is to enhance the uptake of adaptive and mitigation measures as a matter of urgency, which is a corrective measure to sustainable economic development. However, the author noted that uptake of the policies will be difficult as a result of divergent political timescales and the multiple stakeholders required to resolve issues resulting from the phenomenon (Marotzke, 2019). Following the inevitability of uncertainty in climate change modelling, it is important to cope and understand them. This suggestion was made by IPCC (2014) after concluding that during climate change prediction, uncertainties are unavoidable and so many that some are not even known. From the IPCC suggestion, novel approaches that take into account different responses and perceptions to uncertainty and use bottom-up methods during climate change assessment have emerged (Conway, Nicholls, Brown, Tebboth & Adger 2019). The approaches alongside intensified research are set to reduce the uncertainty levels with time since scientists will fill in missing knowledge gaps and improve the decision support tools by grounding them on observations, which overall will improve predicted results. Lewandowsky et al. (2014) agreed with these suggestions by stating that low uncertainty is associated with reduced damages from warnings and enhanced uptake of mitigation measures following easier agreements among the stakeholders involved in climate change planning.

ECONOMIC EFFECTS OF CLIMATE CHANGE

Many authors have positively correlated global warming to deteriorating wellbeing (Burke, Solomon & Miguel, 2015; Burke & Emerick, 2016; Dafermosa et al., 2018; Gelzins & Steele, 2019). Climate change can reduce economic growth potential in the long-term because it diverts resources meant for investment in innovation and current productive capital towards the uptake of mitigation and adaptation measures. Additionally, the phenomenon reduces labour productivity according to the Network for the Greening Financial System (NGFS, 2019). Despite these economic impacts, there is limited understanding by financial markets and investors on the impacts of climate change shocks on productivity and output as highlighted by the International Monetary Fund, IMF (2018).

Climate change usually influences economic well-being in many ways. These include physical annihilation of capital due to extreme weather such as floods and fires, increased costs of providing healthcare, declining productivity of labourers exposed to rising heat and temperatures, and reducing agricultural yields resulting from extended droughts and land degradation. Additionally, adverse spillovers from more vulnerable countries and biodiversity loss resulting from climate change (Nyika, 2020, 2021). The phenomenon and its effects also endanger fiscal and macroeconomic stability by multiplying the amounts of subsidies need for social welfare and to the economy and through infrastructural disruption and subsequent destruction. Consequently, aspects of social welfare and infrastructure worsen economic aspects such as inflation, unemployment, financial costs, public debt, and overall economic growth. These factors lead to increased prices of goods and services particularly food, water, insurance, and agricultural products just to name a few.

To support the argument that climate change has economic consequences, many documented studies have confirmed this. According to Sevillano and Gonzalez (2019), huge capital investments are spent on developing new reserves although the current reserves supersede the carbon budget, and while only

a minimal fraction of fossil fuel reserves are combustible if the temperature rises are to be maintained below 2°C by 2050. Such investments result in wasted capital and are not worth pursuing as they worsen the current climate change and global warming state. Companies that pursue higher release of CO₂ are referred to us as ‘brown’ and as observed by Gorgen, Jacob, Nerlinger, Riordan, Rohleder and Wilkens (2017), they have dismal performances on the stock exchange markets compared to companies pursuing greener technologies of production. Fabris (2020) also stated that rising temperatures have negative effects on labour productivity and labour supply. In this context, rising temperatures lower productive capacities enhances diseases such as heart attack, heat stress, and mortalities. As such, the adaptation to climate change would mean diverting some of the investments of creating new products to reducing the negative effects of global warming such as the installation of air conditioners at workplaces.

The precise fluctuations in the gross domestic product (GDP) and overall economic wellbeing resulting from climate change are difficult to estimate. However, several suggestions have determined the predisposition of economic performance in events of inaction towards climate change adaptation and mitigation. Organisation for Economic Co-operation and Development, OECD (2015) for instance noted that annual GDP losses will rise to a range of 1-3.3% by 2060 and this could worsen to 12% by 2100 if no action against climate change is taken. Similarly, Burke et al. (2015) approximated 23% reductions in GDP by 2100 in a similar scenario as OECD. Global financial losses were estimated to rise by \$ 23 trillion annually over the next 80 years if the global warming rate exceeded 4°C compared to pre-industrial levels (Gelzinis & Steele, 2019). A study by Dietz et al. (2016) also concluded that 2% of the global financial assets will be in jeopardy if the average surface temperatures rise by 2.5°C compared to the pre-industrial levels. Gelzinis and Steele (2019) also foresaw that US homes worth more than \$ 900 billion would be submerged in water if the sea level rises by 6 feet in 2100 as has been projected due to climate changes. In another study, Lagarde (2020) approximated global economic losses to have escalated to \$ 150 billion in 2019 up from \$ 60 billion in 1980 with the peak being 2018 at \$ 350 billion as a result of climate change effects. It is worth noting that these estimates though pointing to a similar trend of increased economic losses are dissimilar due to the uncertainty aspects discussed earlier in this chapter.

The economic damages of climate change vary based on the regions and countries assessed. According to the Organisation for Economic Co-operation and Development, OECD (2015), 23 of the 25 countries it analysed were found to suffer from negative economic consequences due to climate change. The extent to which these countries will suffer from the resultant climate change consequences varies based on their vulnerability level and their adaptation and mitigation capability through approaches such as the adoption of international trade flows, consumer behaviour readjustments, devising greener production structures, technologies, and plans and setting up climate change protection structures. According to Nyika (2020), developing countries will be severely affected economically compared to developed countries as their adaptive capacity to climate change is low despite their high vulnerability to the phenomenon. Similarly, NGFS (2018, 2019) highlighted that countries with low adaptive capacity, low flexibility of capital markets, a public infrastructure with reduced climate resilience, and low production diversity will be severely affected.

The sensitivity to climate change also varied based on different industries and economic sectors. Tourism, agricultural, and energy (relating to carbon fuels) sectors will be severely affected as a result of the induction of carbon taxes and the introduction of stringent environmental pollution regulations focused on lower GHG emissions. The IMF (2019) however cautioned that in making such conclusions, the possibility that stakeholders in the energy sector among other global warmers will devise measures

The Relationship Between Climate Change and Financial Stability

to resist climate change should not be ignored. Some of the economic consequences of climate change in various sectors are summarized in Table 1.

Table 1. Impact of climate change based on various economic sectors

Sector	Economic Impacts of Climate Change
Agricultural	-Reducing agricultural land -Low yields and productive capacity
Health	-Increased medical expenditure
Fishery	-Slow fish maturation and lower catches
Industrial and Energy	-Growth in green energy use compared to conventional energy sources - Economic depression and closure of plants associated with large CO ₂ emissions -Introduction of carbon taxes
Financial	-Increase in write-offs and bad loans -increased number of paid insurance premiums -Decreased value associated with personal financial instruments
Construction	-Reduced labour output resulting from heat stress -Increased investments to meet standards meant to enhance climate change resilience
All sectors	-Capital and asset losses resulting from extreme weather such as hurricanes, sea level rises, and floods

IMPACTS OF CLIMATE CHANGE ON FINANCIAL STABILITY

Climate change has the capacity to affect financial systems through a combination of risks that are either transition or physical according to NGFS (2019). The Bank of England put into perspective the risks of climate change stating that,

The future will be past. Climate change is a tragedy of the horizon that will impose major costs on future generations that the current one has no direct incentive to fix. The catastrophic impacts of climate change will be felt beyond the horizons of most actors. Once climate change becomes a clear and present danger to financial stability it may already be too late to stabilise the atmosphere (2018).

Similarly, Gelzinis and Steele (2019) shared their input suggesting that the increase of extreme weather events as an effect of climate change will lower the value of destroyed assets and eventually strain the investors' ability to pay lenders. Consequently, credit portfolio losses due to increased loan defaulters will rise. Brainard (2019) suggested that the value associated with assets should consider climate change risks failure to which, financial losses will occur and transfer the effects to the economy as reduced lending abilities. As such, financial systems that resist or have a low vulnerability to climate risks should be adopted going forward.

Some studies conducted in banks of developing countries have shown that the banking sector has started taking caution of climate risks in the services they offer (Sevillano & Gonzalez, 2019). However, the challenge is in identifying, quantifying, and managing its exposure to such risks making their predictions even more difficult. Usually, the challenge as Fabris (2020) noted is that risks such as the

transition ones only manifest in the long term while financial systems accounting is limited to short-term risk assessment. It is this trend that the former governor of the Bank of England referred to as the ‘tragedy of the horizon’ in that these risks are not visible and describable and hence, there will be lax in climate change adaptation and prevention in the financial sector (Carney, 2015).

The risks resulting from climate change are systemic in that they interfere with the normal functioning of economies and have negative consequences. In this chapter, the focus is to discuss the two main classes of risks associated with the phenomenon. This initiative is informed by the immense magnitude of economic losses that have been associated with both risk categories (physical and transition) on specific financial institutions and the global financial market. At the institutional level, the provision of substantial financing to investments and activities that enhance global warming and climate change intensifies the apparent risks. In the US for instance, six of Wall Street’s largest banks invested at least \$ 700 billion into fossil fuel productive activities between 2016 and 2018 (Rainforest Action Network, 2019). Similarly, the largest insurers of the region held \$ 528 billion in conventional energy investments based on a 2016 survey (International Association of Insurance Supervisors Forum, 2018). The holding of assets affiliated with carbon-intensive companies has risen by 20% between 2018 and 2020 despite the apparent risk as the focus moves to lowering carbon emissions.

Irrespective of whether the risk is physical or transition, its magnitude does not only depend on the climate changes but also the actions or inactions taken towards mitigation. Therefore, the transition to low-carbon economies in an orderly way is inevitable for positive change to be realized (NGFS, 2019). Usually, the introduction of some policy responses on climate change reduces its associated physical risks but concurrently, results in a disorderly adjustment to carbon avoidance in economies that could manifest as a transition risk in the short-term. On the other extreme, inaction or postponement of the policy response could prevent the transition risk but increase the manifestation of physical risks over time. In this context, it is necessary to note the tandem interaction of both physical and transition risks in the planning for climate change adaptation and mitigation measures. Pointner and Ritzberger-Grunwald (2019) alluded to a relationship between physical and transition risks in that the latter facilitates a reduction of the former. Similarly, the more prone the environment becomes to physical risks the higher the demand to transition and so is the associated transition risk increase.

Categories of Climate Change Risks

Risks associated with climate change and financial stability are divided into two main categories: 1) physical and 2) transition risks. Other smaller categories of risks also exist. These risks and their interrelationships are discussed in subsequent sub-sections. It is worth noting that the magnitude and the interrelationship of these risks is based on the climate change state of a given region and the mitigation actions being put in place.

Physical Risks

Climate-related risks that are physical such as heatwaves, floods, droughts, hurricanes, and storms result in financial and economic losses especially if their severity and frequency increase (Bolton, Despres, Pereira da Silva, Samama & Svartzman 2020). The economic damage is not only limited to banks and insurance companies but also spans to financial intermediaries to the affected assets and industries either directly or indirectly. Long-term physical changes in climate patterns including unpredictable precipita-

The Relationship Between Climate Change and Financial Stability

tion magnitude and frequency, sea-level rise, and ocean acidification that result from effects of growing GHG emission also fall under this category (Dafermos et al., 2018). Physical risks usually influence the demand and supply aspects of an economy. Extreme weather destroys infrastructure and disrupts trade and business activities, which negatively affects the supply of goods and provision of services. In addition, it redirects capital meant for innovation and technology to replacement and reconstructive activities (Batten, 2018). Other aspects of output growth such as the amount of funds directed to research and development, costs of replacements and repairs, capital stock depreciation, and labour productivity are also adversely affected by physical risks (Pointner & Ritzberger-Grunwald, 2019). The effects on supply are also transferred to the demand side. With the reduced investment, the demand for certain goods and services is lowered. Private consumption will undergo depression in favour of precautionary saving at the household level while businesses will thrive under uncertainty on their growth, pricing, and demand prospects due to physical risks as Parker (2018) highlighted.

The complex relationship and interconnectedness of financial institutions enhance the transfer of resultant physical risks. For instance, in the US and within the 2016 and 2018 period, 45 extreme weather events were experienced resulting in more than \$ 1 billion losses. In the same period, yearly economic losses from natural disasters totalled \$ 150 billion, which is a massive increase compared to the last decade (Karsner, 2019). Globally, at least 6 of the natural disasters occurring yearly caused more than \$ 1 billion losses in damage and a total of approximately \$ 50 billion in the period between 1980 and 2019 (National Oceanic and Atmospheric Administration, 2021). Estimates from the Economist's Intelligence Unit (2015) show that global private investor losses due to physical risks of extreme weather range between \$ 4.3 and \$ 13.8 trillion depending on the specific event.

Insurance companies whose core business demands them to guarantee investors on losses on their physical property and assets bear the brunt of physical risks resultant from climate change. With this precognition, these financial intermediaries are working to readjust their underwriting practices and predictions on losses during this climate change era. Consequently, the industry has become vulnerable to huge losses from disasters, which were out of human imagination such as was the case with Hurricane Andrew (Sarkis, 2017; Bradley & Nicole, 2018). The lack of reliable historical data and erratic weather patterns have severely affected the insurance business. The depression experienced by insurance companies due to physical risks of climate change can be transferred to banking and non-banking financial institutions in an exposure channel of systemic risk transmission as highlighted by the Financial Stability Oversight Council, FSOC (2012).

The banking system is also directly affected by the physical risks of climate change. Agricultural, business, commercial real estate loans and mortgages as well the derivative instruments affiliated to their markets have grown susceptible to climate change associated losses in many countries (Gelzinis & Steele, 2019). It is from these events that the value of damaged assets diminishes and so is the ability of debt payment to lenders. For instance, in events of sea-level rise by 6 feet, it is expected that 50% of the housing stock for approximately 300 cities across the globe and worth \$ 900 billion will be lost by 2100 (Roa, 2017). The physical risks of banks and other financial intermediaries could worsen if insurance companies pulled out of specific business lines and geographies as they perceive them more vulnerable to climate change. The duress in the bank could spill to other financial units via asset liquidation. Apart from the direct economic effects of physical risks, indirect effects in the form of second-order disturbances at local and regional levels could occur. The disturbances include higher poverty levels, lower housing prices, and outmigration (Boustan, Kahn, Rhode & Yanguas, 2020).

Transition Risks

Transition risks result from the shift from higher to lower carbon economies through changes in investor and household preferences, technology, and public regulations that affect demand and economy especially the value of financial assets (Caldecott, Howarth & McSharry 2013). The risks often induce radical uncertainty on low carbon pathways to take to reduce GHGs, the methods to use, and concurrently restructure the economy. According to Caldecott, Harnett, Cojoianu, Kok and Pfeiffer (2016), over the last ten years, stranded assets resulting from new regulatory and societal responses meant to reduce global warming have increased. The assets are a result of conversions to liabilities, devaluations, premature and unanticipated write-downs (Ansar, Caldecott & Tilbury, 2013). Research by McGlade and Ekins (2015) observed that more than 30% of the present oil reserves, 50% of gas reserves, and nearly all coal reserves (90%) would transform into stranded assets if the global temperature targets of the Paris Agreement are met and implemented globally.

In an event that policymakers enacted the stipulated decarbonisation policies and technological innovations focused on low carbon products then existent carbon-sensitive assets in the industrial, transportation, energy, and utility sector could lose value (Fabris, 2020). Consequently, carbon prices would escalate to worsen the stranding of fossil fuel assets while lowering the value of assets associated with carbon prices. According to Tooze (2019), more than 30% of fixed income assets and all equity from carbon-sensitive industries is likely to be lost during the transition to low-carbon economies. Additionally, stranded assets worth \$ 18 trillion could be lost during transitioning according to Gelzinis and Steele (2019). Re-evaluation of stranded assets transfers the transition risk in the form of losses to financial intermediaries and investors holding them. This would result in a price shock in the entire financial system since investors would sell their assets at prices below market value, creditors and insurers could avoid firms vulnerable to re-evaluation and affected firms would not be in a capacity to pay creditors leading to exposure transmission channels and liquidation (Knight & Ganguly, 2018). The losses could therefore result in instability in the financial systems and knock-on impacts on the entire economy. Carney (2015) described such a scenario as a 'climate Minsky moment' referring to the reductions in asset value resulting from carbon price bubbles and causing financial instability.

Pointner and Ritzberger-Grunwald (2019) in advocating for transitioning to low carbon economies advocate for smooth and early transition since it is less risky compared to abrupt adjustment of assets. Investors and financial firms could encourage the smooth transition by pricing the costs of a shift to low-carbon economies over time and modifying their risk management models and frameworks to suit this vision accordingly (Aglietta & Espagne, 2016). These initiatives however do not shield them from losses associated with high carbon sensitive assets but allow the leveraging of opportunities to support greener industries financially. Regulators of climate change policy should however not expect the changes to occur unless with stringent enforcement to safeguard investors and taxpayers. Gelzinis and Steele (2019) advocated for urgent initiatives to address climate change by policymakers to prevent disorderly re-evaluation of carbon-sensitive assets towards a green economy free of financial crises of the transition.

Other Risks

Both physical and transition risks result in other risk subcategories. These include liability, market, credit, and operational risks (Fabris, 2020). Liability risks occur when firms are directly or indirectly declared legally responsible for climate change-associated losses and are legally obliged to compensate

The Relationship Between Climate Change and Financial Stability

other parties (Monnin, 2018). This scenario occurs if firms do not manage transition risks appropriately as directed by the polluter pays principle. Greener organisations could partially internalize negative externalities of unmitigated climate change by seeking compensation from firms that engage in GHG emitting activities (Oguntuase, 2020). The risk of unfavourable market price fluctuations is referred to as market risk. Banks are prone to this risk category due to the securities they hold. For instance, in the event of climate change, the sovereign risk increases leading to a country's credit rating deterioration and a lower value for government securities held by banks (Fabris, 2020). The operation of some financial institutions could be interfered with by extreme weather such as floods leading to their closure and subsequently operational risk. Climate change also induces credit risk and the reduced ability of firms to repay debts. This occurs due to the introduction of carbon taxes, a ban on some technologies considered CO₂ intensive, reduced collateral value on assets, and a higher defaulting rate due to the effects of the phenomenon.

THE WAY FORWARD TO CLIMATE CHANGE RISK MANAGEMENT

Climate change results in uncertainty in the future and pre-historical data has not been sufficient to provide support for current actions against this phenomenon. With this precognition, risk management has been proposed as an effective tool towards mitigation and adaptation (Godden, Rochford, Peel, Caripis & Carter, 2013). Risk management consists of tools suited for climate change adaptation and meets predefined national and international standards to assist communities, businesses, and governments in this process (May & Plummer, 2011). The guide on climate change risk assessment, understanding of vulnerability, and plans on risk assessment implementation are highlighted by the ISO 14090:2019 document titled, "Adaptation to climate change". In addition to internal frameworks on climate change, the European Central Bank (2020) advocates for institutional frameworks extending to internal units and business lines on climate change risk reduction. The frameworks should consider all financial, non-financial, off- and on-balance risks of the present and future.

Other researchers advise on the steps to take to enhance climate change risk management. Eceiza, Harreis, Hartl and Viscardi (2020) advised on the following for better climate risk management:

1. The need to prioritize initiatives of climate risk management across all organization levels rooted in good governance
2. The building of business models and strategic plans that consider climate-related risks and allocate capital for such provisions
3. The need to inject climate change risk considerations in the mainstream risk management process of an organization and align them with the apparent risk appetite
4. Perform periodic stress tests and scenario analysis to enhance organizational resilience to climate change
5. Build capacity and technology to manage climate change risks and monitor and evaluate progress gained frequently

The recommendations enhance climate change awareness and promote preparedness for its associated events and effects not only financially but at all other viewpoints. The suggestions are also supported by Prudential Regulation Authority (2019) and the French Prudential Supervision and Resolution Au-

thority (2020) who propose the integration, implementation, monitoring, and evaluation of climate risk management plans for improved preparedness and understanding of climate change effects. Similarly, Zhao et al. (2018) provided three suggestions on climate change including:

1. The revamping of monitoring and evaluation systems. This could be done through the advanced technologies such as the Internet of Things for data acquisition on monitoring, warning provisions and climate forecasting in relation to various economic sectors.
2. Regional and departmental collaborations in devising and implementing mitigation and adaptation measures is crucial for coordinated mitigation and adaptation. Such collaborations enable cost benefit analysis of proposed measures and synergized action.
3. The authors also advocated for security and policy systems to enhance environmental management in general and enforce the uptake of mitigation and adaptation measures in place stringently.

CONCLUSION

Climate change is an established jeopardy to economic growth and financial systems. In this chapter, climate change is shown to cause systemic financial problems leading to reductions in GDP. Additionally, the phenomenon is shown to cause physical, transition, liability, market, operational and credit risks using named examples. The risks can reduce the value of assets that are carbon sensitive leading to losses on investments, liquidation of firms, and the inability of investors to pay their debts. With the effects of climate change and the phenomenon's associated risks worsening, it is a wake-up call to financial regulators to devise measures on climate risk management at all economic sectors and institutional levels. These climate risk management plans must be founded on good governance, awareness creation on the need for climate change adaptation, allocation of funds, continuous evaluation, and monitoring of implemented measures. This will enable the best predictions of risks, the identification of their associated uncertainties, and a smooth shift to greener technologies and production activities.

REFERENCES

- Aglietta, M., & Espagne, E. (2016). *Climate and finance systemic risks, more than an analogy? The Climate Fragility Hypothesis*. CEPII Working Paper 2016-10.
- Ansar, A., Caldecott, B., & Tilbury, J. (2013). *Stranded assets and the fossil fuel divestment campaign: What does divestment mean for the valuation of fossil fuel assets?* University of Oxford's Smith School of Enterprise and the Environmental Stranded Assets Programme Working Paper.
- Arrhenius, S. (1896). On the influence of carbonic acid in the air upon the temperature of the ground. *Philosophical Magazine and Journal of Science*, 41(251), 237–276. doi:10.1080/14786449608620846
- Batten, S. (2018). *Climate change and the macro-economy: a critical review*. Bank of England Staff Working Paper No. 706.
- Batten, S., Sowerbutts, R., & Tanaka, M. (2016). *Let's talk about the weather: The impact of climate change on central banks*. Bank of England Staff Working Paper 603.

The Relationship Between Climate Change and Financial Stability

Battiston, S., Mandel, A., Monasterolo, I., Schütze, F., & Visentin, G. (2017). A climate stress test of the financial system. *Nature Climate Change*, 7(4), 283–288. doi:10.1038/nclimate3255

Bolton, P., Despres, M., Pereira da Silva, L., Samama, F., & Svartzman, R. (2020). *The green swan: central banking and financial stability in the age of climate change*. Bank for International Settlements.

Boustan, L., Kahn, M., Rhode, P., & Yanguas, M. (2020). The effect of natural disasters on economic activity in US countries: A century of data. *Journal of Urban Economics*, 118, 103257. doi:10.1016/j.jue.2020.103257

Bovari, E., Giraud, G., & Mc Isaac, F. (2018). Coping with collapse: A stock-flow consistent monetary macrodynamics of global warming. *Ecological Economics*, 147, 383–398. doi:10.1016/j.ecolecon.2018.01.034

Bradley, H., & Nicole, F. (2018). Climate Change is Forcing the Insurance Industry to Recalculate. *The Wall Street Journal*. <https://www.wsj.com/graphics/climate-change-forcing-insuranceindustry-recalculate/>

Brainard, L. (2019). *Why climate change matters for monetary policy and financial stability*. In *Research conference “The Economics of Climate Change”*. Federal Reserve Bank of San Francisco.

Burke, M., & Emerick, K. (2016). Adaptation to climate change; Evidence from US agriculture. *American Economic Journal*, 8(3), 106–140. doi:10.1257/pol.20130025

Burke, M., Solomon, M., & Miguel, E. (2015). Global nonlinear effect of temperature on economic production. *Nature*, 527(7577), 235–239. doi:10.1038/nature15725 PMID:26503051

Caldecott, B., Harnett, E., Cojoianu, T., Kok, I., & Pfeiffer, A. (2016). *Stranded assets: a climate risk challenge*. Inter-American Development Bank. doi:10.18235/0000517

Caldecott, B., Howarth, N., & McSharry, P. (2013). *Stranded assets in agriculture: protecting value from environment-related risks*. Smith School of Enterprise and Environment Working Paper.

Carney, M. (2015). *Breaking the tragedy of the horizon-Climate change and financial stability*. Speech given on Lloyd’s of London by the governor of the Bank of England. Available from: <https://www.bankofengland.co.uk/publications/Pages/speeches/2015/544.aspx>

Conway, D., Nicholls, R., Brown, S., Tebboth, M., Adger, W., Ahmad, B., Biemans, H., Crick, F., Lutz, A. F., De Campos, R. S., Said, M., Singh, C., Zaroug, M. A. H., Ludi, E., New, M., & Wester, P. (2019). The need for bottom-up assessments of climate risks and adaptation in climate-sensitive regions. *Nature Climate Change*, 9(7), 503–511. doi:10.1038/41558-019-0502-0

Cook, J., Oreskes, N., Doran, P., Anderegg, W., Verheggen, B., Maibach, E. W., Carlton, J. S., Lewandowsky, S., Skuce, A. G., Green, S. A., Nuccitelli, D., Jacobs, P., Richardson, M., Winkler, B., Painting, R., & Rice, K. (2015). Consensus on consensus: A synthesis of consensus estimated on human-caused global warming. *Environmental Research Letters*, 11(4), 048002. doi:10.1088/1748-9326/11/4/048002

Dafermos, Y., Nikolaidi, M., & Galanis, G. (2017). A stock-flow fund ecological macro-economic model. *Ecological Economics*, 131, 191–207. doi:10.1016/j.ecolecon.2016.08.013

Dafermos, Y., Nikolaidi, M., & Galanis, G. (2018). Climate change, financial stability, and monetary policy. *Ecological Economics*, 152, 219–234. doi:10.1016/j.ecolecon.2018.05.011

Dietz, S., Bowen, A., Dixon, C., & Gradwell, P. (2016). Climate value at risk' of global financial assets. *Nature Climate Change*, 6(7), 676–679. doi:10.1038/nclimate2972

Eceiza, J., Harreis, H., Hartl, D., & Viscardi, S. (2020). *Banking imperatives for managing climate risk*. McKinsey & Company.

Economist Intelligence Unit. (2015). *The cost of inaction: reorganising the value at risk from climate change*. https://eiuperspectives.economist.com/sites/default/files/The%20cost%20of%20inaction_0.pdf

European Central Bank. (2020). *Positively green: measuring climate change risks to financial stability*. <http://financial-stability.org/measuring-climate-change-risks-to-financial-stability/>

Fabris, N. (2020). Financial stability and climate change. *Journal of Central Banking Theory and Practice*, 3(3), 27–43. doi:10.2478/jcbtp-2020-0034

Financial Stability Board. (2020). *The implications of climate change for financial stability*.

Financial Stability Oversight Council. (2012). Authority to require supervision and regulation of certain nonbank financial companies. *Federal Register*, 77(70), 21637–21662.

French Prudential Supervision and Resolution Authority. (2020). *Governance and management of climate related risks by French banking institutions: some good practices*. Author.

Gelzini, G., & Steele, G. (2019). *Climate change threatens the stability of the financial system*. Centre for American Progress.

Godden, L., Rochford, F., Peel, J., Caripis, L., & Carter, R. (2013). Law, governance, and risk: Deconstructing the public-private divide in climate change adaptation. *The University of New South Wales Law Journal*, 36(1), 224–255.

Gorgen, M., Jacob, A., Nerlinger, M., Riordan, R., Rohleder, M. & Wilkens, M. (2017). *Carbon risk*. University of Augsburg, Working 672019.

Heal, G., & Milner, A. (2013). *Uncertainty and decision in climate change economics*. National Bureau of Economic Research Working Paper 18929.

Intergovernmental Panel on Climate Change (IPCC). (2018). *Global warming of 1.5 C*. https://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf

Intergovernmental Panel on Climate Change (IPCC). (2019). *IPCC special report on the ocean and cryosphere in a changing climate*. https://www.ipcc.ch/site/assets/uploads/sites/3/2019/11/03_SROCC_SPM_FINAL.pdf

International Association of Insurance Supervisors and Sustainable Insurance Forum. (2018). *Issue paper on climate change risks to the insurance sector*. https://www.unepfi.org/psi/wp-content/uploads/2018/08/IAIS_SIF_-Issues-Paperon-Climate-Change-Risks-to-the-Insurance-Sector.pdf

International Monetary Fund (IMF). (2018). *World Economic Outlook*. IMF.

The Relationship Between Climate Change and Financial Stability

IPCC (Intergovernmental Panel on Climate Change). (2014). *Climate change 2014: synthesis report. Contribution of working groups I, II, and III to the fifth assessment report of the intergovernmental panel on climate change*. Geneva, Switzerland: IPCC. Available from: https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf

Kalra, H., Hallegate, S., Lempert, R., Brown, C., Fozzard, A., & Gill, S. (2014). *Agreeing on robust decisions: New processes for decision making under uncertainty*. World Bank Research Working Paper 6906.

Karsner, A. (2019). *Testimony before the house financial services subcommittee on national security*. International Development and Monetary Policy. <https://financialservices.house.gov/uploadedfiles/hhrg-116-ba10-wstate-karsnera-20190911.pdf>

Knight, Z., & Ganguly, G. (2018). *Managing financial system stability and climate change-a preliminary guide*. HSBC Centre of Sustainable Finance.

Kompas, T., Pham, V., & Che, Y. (2018). The effects of climate change on GDP country and the global economic gains from complying with the Paris climate accord. *Earth's Future*, 6(8), 1153–1173. doi:10.1029/2018EF000922

Kunreuther, H., Heal, G., Allen, M., Edenhofer, O., Field, C., & Yohe, G. (2012). *Risk management and climate change*. NBER Working Paper 18607.

Lagarde, C. (2020). *Climate change and the financial sector. At the launch of the COP 26 private finance agenda*. https://www.ecb.europa.eu/press/key/date/2020/html/ecb.sp200227_1~5eac0ce39a.en.html

Lewandowsky, S., Risbey, J., Smithson, M., Newell, B., & Hunter, J. (2014). Scientific uncertainty and climate change: Part 1, Uncertainty and unabated emissions. *Climatic Change*, 124(1-2), 21–37. doi:10.1007/10584-014-1082-7

MacWilliams, J., LaMonaca, S., & Kobus, J. (2019). *PG&E: Market and policy perspectives on the first climate change bankruptcy*. SIPA Centre on Global Energy Policy.

Marotzke, J. (2019). Quantifying the irreducible uncertainty in near term climate projections. *Wiley Interdisciplinary Reviews: Climate Change*, 10(1), 1–12. doi:10.1002/wcc.563

May, B., & Plummer, R. (2011). Accommodating the challenges of climate change adaptation and governance in conventional risk management: Adaptive collaborative risk management. *Ecology and Society*, 16(1), 47. doi:10.5751/ES-03924-160147

McGlade, C., & Ekins, P. (2015). The geographical distribution of fossil fuels unused when limiting global warming to 2°C. *Nature*, 517(7533), 187–190. doi:10.1038/nature14016 PMID:25567285

Mehta, L., Adam, H., & Srivastava, S. (2019). Unpacking uncertainty and climate change from above and below. *Regional Environmental Change*, 19(6), 1529–1532. doi:10.1007/10113-019-01539-y

Monnin, P. (2018). *Central banks should reflect climate risks in monetary policy operations*. SUERF Policy Note Issue No. 41.

National Oceanic and Atmospheric Administration. (2021). *Billion dollar weather and climate disasters: overview*. <https://www.ncdc.noaa.gov/billions/>

- Network for the Greening Financial System. (2018). *NGFS first progress report*. <https://www.banque-france.fr/sites/default/files/media/2018/10/11/818366-ngfs-first-progress-report-20181011.pdf>
- Network for the Greening Financial System. (2019). *A call for action: climate change as a financial risk*. [france.fr/sites/default/files/media/2019/04/17/ngfs_first_comprehensive_report_-_17042019_0.pdf](https://www.banque-france.fr/sites/default/files/media/2019/04/17/ngfs_first_comprehensive_report_-_17042019_0.pdf)
- Nyika, J. (2020). Climate change situation in Kenya and measures towards adaptive management in the water sector. *International Journal of Environmental Sustainability and Green Technologies*, 11(2), 34–47. doi:10.4018/IJESGT.2020070103
- Nyika, J. (2021). Climate change on fertility and reproductive processes of female livestock. In A. Wani & N. Naha (Eds.), *Climate change and its impact on fertility*. IGI Global. doi:10.4018/978-1-7998-4480-8.ch013
- Oguntuase, O. (2020). *Climate change, credit risk, and financial stability*. IntechOpen. doi:10.5772/intechopen.93304
- Parker, M. (2018). The impact of disasters on inflation. *Economics of Disasters and Climate Change*, 2(1), 21–48. doi:10.1007/41885-017-0017-y
- Pointner, W., & Ritzberger-Grunwald, D. (2019). Climate change as a risk to financial stability. *Financial Stability Report*, 38, 30–45.
- Prudential Regulation Authority. (2019). *Enhancing banks' and insurers' approaches to managing the financial risks from climate change*. Supervisory Statement/SS3/19.
- Rainforest Action Network. (2019). *Banking on climate change: fossil fuel finance report card*. https://www.ran.org/wp-content/uploads/2019/03/Banking_on_Climate_Change_2019_vFINAL1.pdf
- Rao, K. (2017). *Climate change and housing: will a rising tide sink all homes?* <https://www.zillow.com/research/climate-changeunderwater-homes-12890/>
- Ripple, W., Wolfe, C., Newsome, T., Barnard, P., & Moomwa, W. (2019). World scientists' warning of climate emergency. *Bioscience*, 70(1), 8–12.
- Sarkis, S. (2017). *The 25th anniversary of hurricane Andrew*. National Oceanic and Atmospheric Administration. https://www.aoml.noaa.gov/keynotes/keynotes_0817_andrew25.html
- Scott, M., van Huizen, J. & Jung, C. (2017). The Bank of England's response to climate change. *Bank of England Quarterly Bulletin*, 98-109.
- Sevillano, J., & Gonzalez, L. (2019). The risk of climate change for financial markets and institutions: challenges, measures adopted and international initiatives. Banco de España.
- Steffen, W., Rockstrom, J., Richardson, K., Lenton, T., Folke, C., Liverman, D., Summerhayes, C. P., Barnosky, A. D., Cornell, S. E., Crucifix, M., Donges, J. F., Fetzer, I., Lade, S. J., Scheffer, M., Winkelmann, R., & Schellnhuber, H. J. (2018). Trajectories of the earth system in the Anthropocene. *Proceedings of the National Academy of Sciences of the United States of America*, 115(33), 8252–8259. doi:10.1073/pnas.1810141115 PMID:30082409

The Relationship Between Climate Change and Financial Stability

Stolbova, V., Monasterolo, I., & Battiston, S. (2018). A financial macro-network approach to climate policy evaluation. *Ecological Economics*, *149*, 239–253. doi:10.1016/j.ecolecon.2018.03.013

Tooze, A. (2019). *Why central banks need to step up on global warming*. <https://foreignpolicy.com/2019/07/20/why-central-banksneed-to-step-up-on-global-warming/>

Trinks, A., Scholtens, B., Mulder, M., & Dam, L. (2018). Fossil fuel divestment and portfolio performance. *Ecological Economics*, *146*, 740–748. doi:10.1016/j.ecolecon.2017.11.036

World Economic Forum (WEF). (2016). *The global risk report* (11th ed.). WEF.

Zhao, C., Yan, Y., Wang, C., Tang, M., Wu, G., Ding, D., & Song, Y. (2018). Adaptation and mitigation for combating climate change—from single to joint. *Ecosystem Health and Sustainability*, *4*(4), 85–94. doi:10.1080/20964129.2018.1466632

Chapter 9

Sustainability and Green Operations Management: Concept, Theory, and Practice

Hezekiah Oladimeji

Durban University of Technology, South Africa

Shalini Singh

Durban University of Technology, South Africa

Olayinka Olubukola Afolabi

HANDEL Institute, Nigeria

ABSTRACT

For over four decades now there has been global concerns emerging from environmental considerations. Sustainability was introduced subsequently as a concept to reconcile these environmental dynamics with other 'pillars' of sustainable development (social and economic). These global concerns of the environment indicate the importance of green operations management towards optimal utilisation of organisational resources and sustainable management of the entirety of the systems. To this end, this chapter is aimed at providing a review and discussions on relevant historical literature on sustainability and green operations management.

INTRODUCTION

In recent discourse with reference to development, sustainability has taken a popular viewpoint (Mensah and Casadevall, 2019) as a result of climate change becoming a reality (Zubair and Khan, 2019). Since 2005, the attentions of the practitioners and researchers in Operations Research (OR) and Operations Management (OM) have been drawn to the concept of sustainability (Gunasekaran, Irani and Papadopoulos, 2013), green operations management (Ren, Hu, Dong, Sun, Chen, Y. and Chen, Z., 2019) and the concerns about the environment towards the improvement of workplace commitment (Pampanelli,

DOI: 10.4018/978-1-7998-7967-1.ch009

Found and Bernardes, 2015). Researchers in operations management and operational research have, in recent times, been focusing on green operations management (Gunasekaran and Irani, 2014). It has since been observed by Kleindorfer, Singhal and Wassenhove, (2005) and White and Lee (2009) to be vital in resolving the challenges of complex sustainability confronting several organisations. In exploring influencing factors of adopting sustainable operating practices, Muthulingam (2009) raises global awareness about the increasing trends of adoption of these practices in several organisations.

The global definition of sustainability by the Brundtland Commission of 1987 is the conventional viewpoint which is described as the development which does not compromise the future generations to satisfy their needs while the needs of the present generation is being met (Awan, 2013; Subramanian, Semenzin, Hristosov, Marcomini and Linkov, 2014). There has been series of driving forces putting pressures on organisations to shift towards ‘sustainable development’.

The current chapter discusses the concept, theory and practice of sustainability and green operations management. This is important as it relevant as it plays important roles among researchers and practitioners of operations management by providing useful measures capable of monitoring the efforts of organisations (Golicic, Boerstler and Ellram, 2010) and also serve as support to business support decision making processes (Ngniatedema, 2014).

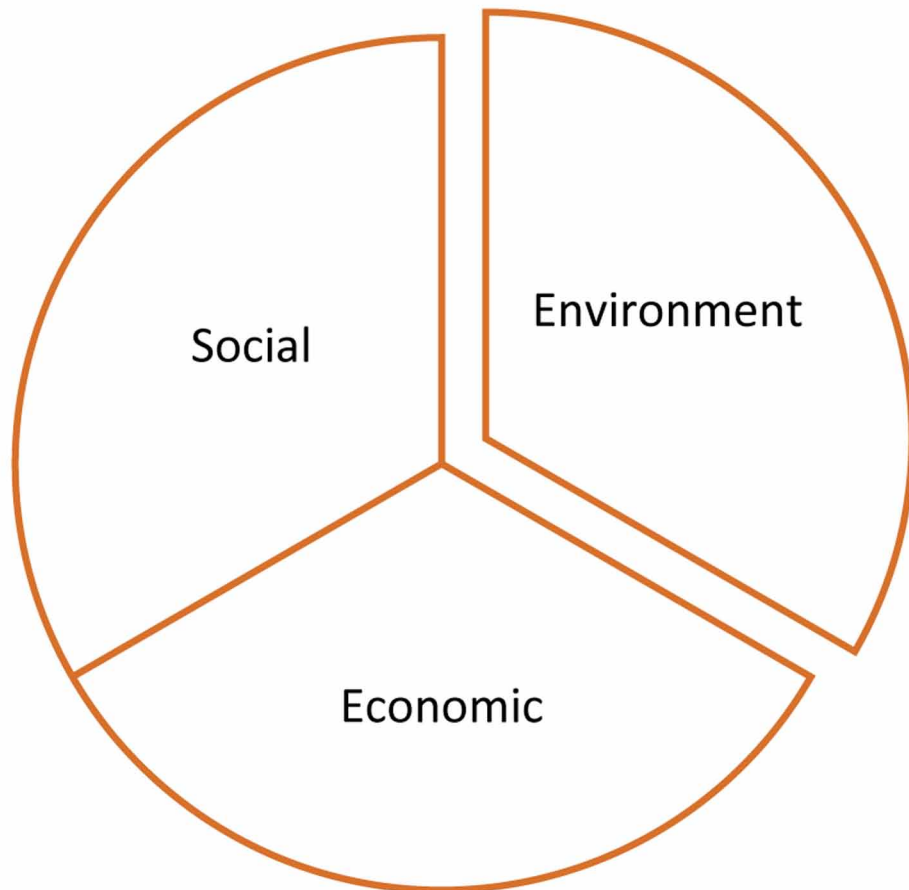
There exist numerous research on sustainability and green operations management (Lele, 1991; Fahimnia, Sarkis and Davarzani, 2015; Machado, Mattioda, Costa, Lima and Winroth, 2018). These and several other literatures are critically reviewed in this chapter towards business growth optimum performance of organisations.

ENVIRONMENTAL ISSUES IN OPERATIONS MANAGEMENT

Walker, Seuring, Sarkis and Klassen (2014) argued that environmental issues have been of growing concerns within the last three decades due to enormous number of changes in business activities and the society at large, leading to global interests in green manufacturing, reverse logistics, recycling and reductions of waste and carbon-monoxide (CO₂) emissions. Necessity for environmental issues in Operations Management evolved over a period of time as the results of numerous environmental misdeeds (Pane-Haden, Oyler and Humphreys, 2009). Today, operations managers are faced with environmental issues in their daily managerial decisions as attempts are made in ensuring success in sustainable economic, business ethics and social values (Molia-Azorin, Claver-Cortes, Lopez-Gamero and Tari, (2009).

The environment, according to Purvis, Mao and Robinson (2018), is identified and discussed as one of the three pillars of sustainable development. This is known to include the environmental factors (or ‘goals’). Others are economic and social as depicted in Fig. 1. These are referred to as ‘dimensions’ in Carter and Moir (2012), described as ‘Perspectives’ in Arushanyan, Ekener and Moberg (2012), termed as ‘stool legs’ in Dawe and Ryan (2003) but viewed as ‘Components’ in Zijp, Heijungs and van der Voet, *et al* (2015). These pillars are the triple bottom line of sustainability (Walker, Seuring, Sarkis and Klassen, 2014)

Figure 1. The three interconnecting 'pillars' of sustainability



Several environmental problems arise from the operational activities of the organisations which have to do with positioning of organisational resources which are used for productions and delivery of goods and services of the organisations (Slack, Chambers and Johnston, 2003). According to Klassen (2000), sustainability could be translated to as the adoption of management of the environment to technological and manufacturing designs and managerial decisions. To this end, Uygur, Musluk and Ilbey (2015) conclude that the purpose of sustainable operations management is to embark on management activities that are suitable for the environment. Opresnik and Taisch (2015) argued that the sustainability of the environment is about their strategies and not just about pure operations. In an exploratory manner and for various kinds of organisations, this chapter is designed to inquire into measures in which conventional operations management is re-oriented towards sustainable operations management.

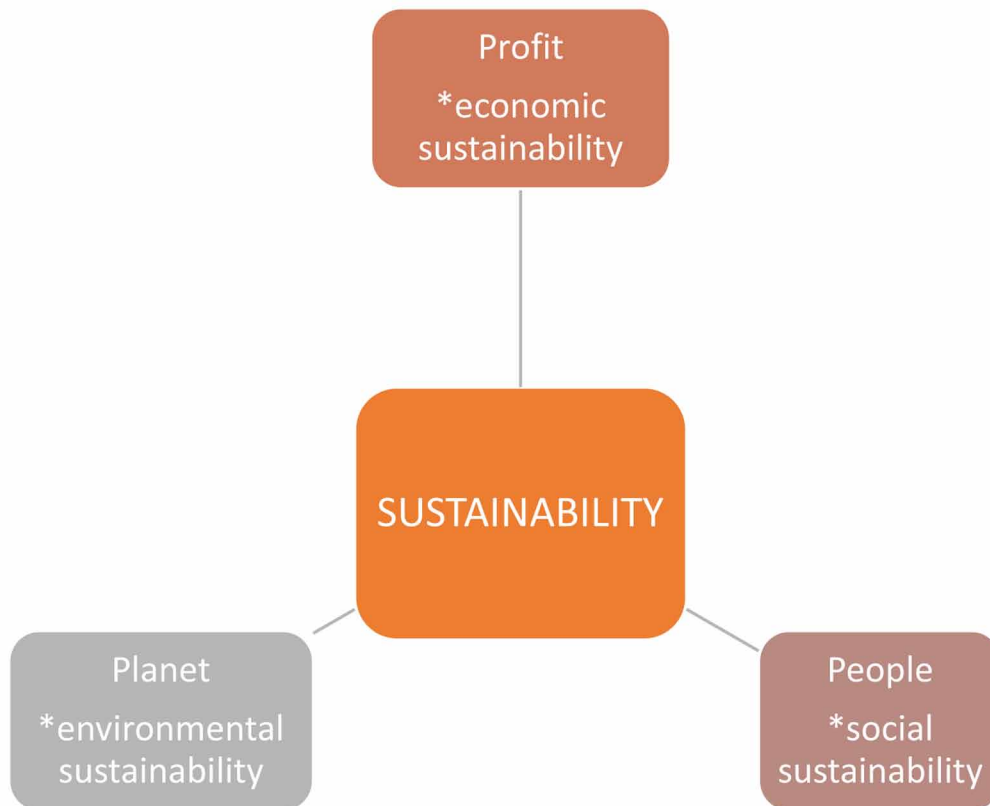
The advent of the Industrial Revolution had generated series of global crises (environmental, food, ecological and energy) due to rapid increase in population and development in production and operational

Sustainability and Green Operations Management

activities (Shi, Han, Yang and Gao, 2019). According to Pane-Haden, Oyler and Humphreys (2009), human behavioural activities during this Industrial Revolution era were environmentally devastating, destructive, damaging and wasteful. This led to the emergence of sustainability (Klarin, 2018). Sustainability is an issue related to the economy (Bermejo, Arto and Hoyos, 2014). It is a dynamic proceeding through which direction of business and investments, use of natural resources, institutional deals and orientation of technological development are designed in alignment with the needs of the current generation without compromising those of the future generations (Khan, H. and Khan, I., 2012).

Belvedere and Grando (2017), in relation to the triple bottom line of sustainability as depicted in figure 1, argue that the objectives of sustainability should be anchored on maximising the 3Ps (People, Profit and Planet) depicted in figure 2.

Figure 2. The 3Ps of sustainability in relations to the triple bottom line



Profit is a measure of financial and economic sustainability in the medium to long-term prospects. The *People* is an evidence of the performance measuring the impact of the business on the society. The performance that sustains the environment is referred to as the *Planet*.

Table 1. Principles of sustainable OM (Adapted from Kurland and Zell (2011))

	Sustainable Principles	Sustainable practices
Principle 1	Establishment of firm's sustainable values	<ul style="list-style-type: none"> • Basic personal values • Basic firm's values
Principle 2	Formulation & Execution of sustainable goals	<ul style="list-style-type: none"> • Installation of facilities that are green or sustainable (Examples are renewable energy sources and recycling efforts). • Sustainable products and services (Example is sourcing local materials)
Principle 3	Design of green metrics to measure progress towards sustainable goals	<ul style="list-style-type: none"> • Assessment of environmental impacts of products/services along the product lifecycles • Focus on measurable metrics • Identification of firm's core interest • Familiarisation with metrics with potential challenges • Reliance on experts (internal or external)
Principle 4	Adoption of case for sustainability	<ul style="list-style-type: none"> • Estimation of ROI (For example, operational goals and their timeframes) • Displaying of operational effectiveness • Linking of fund supports to budget • Arguing strategically for sustainability • Creatively thinking differently • Taking advantages of states' funding
Principle 5	Overcoming resistance to change	<ul style="list-style-type: none"> • Putting in place dedicated and reliable leadership • Being motivated to argue for sustainability • Educating by words and actions • Making green actions look easy • Organising incentives for engagement
Principle 6	Reinforcing green practices and values in the company	<ul style="list-style-type: none"> • Setting up sustainability team with a leader • Institutionalise green practices among the employees • Organising training and consulting • Diffusing green practices through networking • Inculcating sustainability into decision-making process of the organisation • Acknowledging efforts of 'hidden' groups
Principle 7	Getting suppliers on board	<ul style="list-style-type: none"> • Using company's values to drive its choices of suppliers • Using market power to enforce standards • Motivating innovations of the suppliers • Considering the management of 'third party' employees
Principle 8	Engaging with competitors and customers	<ul style="list-style-type: none"> • Collaborating with competitors with similar minds • Providing sustainable solutions for customers
Principle 9	Engaging with NGOs, regulators and entire public	<ul style="list-style-type: none"> • Linking up with NGOs towards resolving environmental issues • Meeting up with updated regulatory standards • Providing literacy and incentives to the consuming public
Principle 10	Being visible	<ul style="list-style-type: none"> • Becoming the 'face of green'

INSTITUTIONALISING 'SUSTAINABLE OPERATIONS MANAGEMENT'

According to Uygur, Musluk and Ilbey (2015), the concept and theory of sustainable development is the starting point of sustainable operation management. Literarily, sustainability can be referred to as a process that can be continued (Lele, 1991). It is a dynamic process that meets the needs of the current generations without compromising the ability of the future ones to meet their own needs (Khan, H. and

Sustainability and Green Operations Management

Khan, I., 2012). There has been increasing interests in environmental or green concerns (Gunasekaran, Irani and Papadoulos, 2013). In relation to the environment,

Form the experiences of thirty (30) sustainability managers, Kurland and Zell (2011) identified ten (10) principles of sustainable operations management which are depicted in Table 1.

Execution of the highlighted principles of sustainable OM will place an organisation at a ‘greener’ advantage, but must be combined with the conventional operational management functions of planning, organising, directing and controlling (Kurland and Zell, 2011).

BENEFITS OF SUSTAINABILITY

Anderson (2004) in Pane-Haden, Oyler and Humphreys (2009) encourages organisations seeking to engage in effective sustainability to embark on the following:

- desist from activities that are harmful to the nature,
- decrease from dependence on materials extracted from the crust of the earth,
- lessen the use of unnatural substances, and
- cut down the use of excessive amount of resources which do not necessarily yield equivalent amount of human value.

Nulkar (2018) identified the benefits (both short-run and long-run) arising from sustainable practices by distributing them into Lower cost benefits and Differentiation benefits as presented in Table 2.

Table 2. Benefits of sustainability to business

Lower cost benefits	Differentiation benefits
Savings from recycling	Image with customers improved
Improvement in resources' productivity	
Savings from reduced materials consumption	Improved morale of workforce
Incentives from financial institutions	Attractive workforce
Reduced environmental risks	Improved products' quality
Lower premiums from insurance firms	Customers are retained

EFFECTS OF SUSTAINABILITY

Smith and Perks (2010), in an empirical study of the effects of the implementation of green activities on the various functions of business, identified several impacts of adopting environmental sustainability.

Table 3. Effects of sustainability on operations management (Culled from Smith and Perks, 2010)

operations	<ul style="list-style-type: none"> ● Profitability through green operations ● Reduction in ecological damage through tree planting ● Usage of alternative materials ● Minimising emissions ● Productive outcomes through lean manufacturing ● Least cost through use of green alternatives to harmful items ● R&D enabled to access new and current sustainable ideas ● Eco-friendly materials and methods are adopted for optimal use of raw materials
marketing	<ul style="list-style-type: none"> ● customers' awareness enhanced ● Green issues used to market fresh ideas ● Customers made aware of health risks of not going green ● Pollution eliminated for new products ● Customers' needs are satisfied for green products, hence ensuring firm's credibility ● New customers are attracted ● Choice of environmentally friendly packaging material ● Environmental awareness among the general public through employees' efforts and supports ● Greater market share through effective advertisement of sustainability initiatives
purchasing/ supply chain management	<ul style="list-style-type: none"> ● Cost and environmental risks eliminated with choice of suppliers with green processes ● Green products are accessed at cheaper rates through e-procurement ● Environment saved through the use and recycling of environmentally-friendly materials ● Non-harmful products are produced through effective supply chain
logistics/ distribution	<ul style="list-style-type: none"> ● Raw materials and finished products are obtained at minimal distance travelling ● Inventory is easily controlled ● Fuel costs are optimised as shortest distribution distance is identified ● Biofuels are used as alternative energy source ● Carbon emissions from movement of goods are limited
finance/IT	<ul style="list-style-type: none"> ● Energy bills are cut through the green activities and facilities ● Recycling policy implemented without incurring extra capital disbursement ● Opportunity for green projects' investment ● Development of auditing systems that are environmentally friendly ● Account staff and board members are made familiar with the sustainability goals ● Paperless administrative system through ICT ● Cost reduced through effective and cheaper means of communication
HUMAN RESOURCE MANAGEMENT	<ul style="list-style-type: none"> ● Recruitment cost reduced through e-recruitment procedures ● Members of the board composed with green concerns ● Implementation of eco-friendly system of management and environment policies through appointments of experts in sustainable development

Tran (2009) opined that effective sustainable processes or products would yield higher productivity at diminishing operating costs through the use of less resources (water, materials and energy) while creating health advantage due to improvement in the atmospheric health condition. Also, there is reduction in the impacts on the environment. Whiting (2021) distributed these benefits into two, the short-run and the long-run benefits.

FUTURE TRENDS AND CONCLUSION

In this chapter, an extensive attempt is made to carry out a critical review of available literature on SOM. This framework has provided a new exposure featuring the adoptions of Operational research tools in SOM is possible. White and Lee (2009) argues that the potential of Operational research should be

exploited in sustainability which has been regarded immensely as global challenge. Consequently, this chapter presents a research framework with the aim of systematically developing principles, theories and practices related to sustainable development and green operations management. As a guideline for future directions, further studies are suggested to include the effects of SOM on organisational effectiveness, the role of individual managers and employees in influencing SOM.

REFERENCES

- Anderson, R. (2004). Climbing Mount Sustainability. *Quality Progress*, 37(2), 32–39.
- Arushanyan, Y., Ekener, E., & Moberg, A. (2017). Sustainability assessment framework for scenarios—SAFS. *Environmental Impact Assessment Review*, 63, 23–34. doi:10.1016/j.eiar.2016.11.001
- Awan, A. (2013). Relationship between Environment and Sustainable Economic Development: A Theoretical Approach to Environmental Problems. *International Journal of Asian Social Sciences*, 3(3), 741–761.
- Belvedere, V., & Grando, A. (2017). *Sustainable Operations and Supply Chain Management*. Wiley. doi:10.1002/9781119383260
- Bermejo, Arto, & Hoyos. (2014). Sustainable Development in the Brundtland Report and Its Distortion: Implications for Development Economics and International Cooperation. In *Development Cooperation: Facing the Challenges of Global Change*. University of Nevada Press.
- Bettley, A., & Burnley, S. (2008). Towards Sustainable Operations Management Integrating Sustainability Management into Operations Management Strategies and Practices. In K. B. Misra (Ed.), *Handbook on Performability Engineering* (pp. 875–904). Springer-Verlag. doi:10.1007/978-1-84800-131-2_53
- Carter, K., & Moir, S. (2012). Diagrammatic representations of sustainability—a review and synthesis. *Proceedings of the 28th annual ARCOM conference*, 1479–1489.
- Dawe, K., & Ryan, L. (2003). The faulty three-legged-stool of sustainable development. *Conservative Biology*, 17(5), 1458–1460. doi:10.1046/j.1523-1739.2003.02471.x
- Fahimnia, B., Sarkis, J., & Davarzani, H. (2015). Green supply chain management: A review and bibliometric analysis. *International Journal of Production Economics*, 162, 101–114. doi:10.1016/j.ijpe.2015.01.003
- Golicic, S., Boerstler, C., & Ellram, L. (2010). ‘Greening’ Transportation in the Supply Chain. *Sloan Management Review*, 51(2), 47–55.
- Gunasekaran, A., & Irani, Z. (2014). Sustainable Operations Management: Design, Modelling and Analysis. *The Journal of the Operational Research Society*, 65(6), 801–805. doi:10.1057/jors.2014.26
- Gunasekaran, A. Irani, Z., & Papadoulos, T. (2013). Modelling and Analysis of Sustainable Operations Management: Certain Investigations for Research and Applications. *Journal of Operational Research*, 1-18.
- Khan, H., & Khan, I. (2012). From Growth to Sustainable Development in Developing Countries: A Conceptual Framework. *Environment and Ecology*, 3(1), 23–33.

- Klarin, T. (2018). The Concept of Sustainable Development: From its Beginning to the Contemporary Issues. *International Review of Economics and Business*, 21(1), 67–94. doi:10.2478/zireb-2018-0005
- Klassen, R. (2000). Environmental Issues and Operations Management. *Encyclopedia of Production and Manufacturing Management*, 187–192. doi:10.1007/1-4020-0612-8_298
- Kleindorfer, P., Singhal, K., & Wassenhove, N. (2005). Sustainable Operations Management. *Production and Operations Management*, 14(4), 482–492. doi:10.1111/j.1937-5956.2005.tb00235.x
- Kurland, N., & Zell, D. (2011). Green Management: Principles and Examples. *Organizational Dynamics*, 40(1), 49–56. doi:10.1016/j.orgdyn.2010.10.004
- Lele, S. (1991). Sustainable Development: A Critical Review. *World Development*, 19(6), 607–621. doi:10.1016/0305-750X(91)90197-P
- Machado, C., Mattioda, R., Costa, S., Lima, E., & Winroth, M. (2018). *Developing capabilities for Sustainable Operations Management*. Conference Paper. https://research.chalmers.se/publication/505337/file/505337_Fulltext.pdf
- Mensah, J., & Casadevall, S. (2019). Sustainable development: Meaning, history, principles, pillars, and implications for human action: Literature review. *Cogent Social Sciences*, 5(1), 1653531. doi:10.1080/23311886.2019.1653531
- Molia-Azorin, J., Claver-Cortes, E., Lopez-Gamero, M., & Tari, J. (2009). Green Management and Financial Performance: A Literature Review. *Management Decision*, 47(7), 1080–1100. doi:10.1108/00251740910978313
- Muthulingam, S. (2009). Environmental issues in operations management. *Dissertation Abstracts International*, 71(6), 2132–2221.
- Ngniatedema, T. (2014). Green Operations and Organisational performance. *International Journal of Business and Social Science*, 5(3), 50–58.
- Nulkar, G. (2018). Environmental sustainability practices for SMEs. In K. Paul, K. Bhattacharyya, & S. Anand (Eds.), *Green Initiatives for Business Sustainability and Value Creation*. IGI Global. doi:10.4018/978-1-5225-2662-9.ch001
- Pampanelli, A., Found, P., & Bernardes, A. (2015). Sustainable Manufacturing: The Lean and Green Business Model. In A. Chiarini (Ed.), *Sustainable Operations Management: Advances in Strategy and Methodology*. Springer. doi:10.1007/978-3-319-14002-5_7
- Pane-Haden, S., Oyler, J., & Humphreys, J. (2009). Historical, practical, and theoretical perspectives on green management. *Management Decision*, 47(7), 1041–1055. doi:10.1108/00251740910978287
- Purvis, B., Mao, Y., & Robinson, D. (2018). The Three Pillars of Sustainability: In Search of Conceptual Origins. *Sustainability Science*, 14(3), 681–695. doi:10.1007/11625-018-0627-5

- Ren, R., Hu, W., Dong, J., Sun, B., Chen, Y., & Chen, Z. (2019). A Systematic Literature Review of Green and Sustainable Logistics: Bibliometric Analysis, Research Trend and Knowledge Taxonomy. *International Journal of Environmental Research and Public Health*, 17(1), 261. doi:10.3390/ijerph17010261 PMID:31905934
- Shi, L., Han, L., Yang, F., & Gao, L. (2019). The Evolution of Sustainable Development Theory: Types, Goals, and Research Prospects. *Sustainability*, 11(24), 1–16. doi:10.3390/u11247158
- Slack, N., Chambers, S., & Johnston, R. (2003). *Operations management* (4th ed.). FT Prentice Hall.
- Subramanian, V., Semenzin, E., Hristosov, D., Marcomini, A., & Linkov, I. (2014). Sustainable nanotechnology: Defining, Measuring and Teaching. *Nano Today*, 9(1), 6–9. doi:10.1016/j.nantod.2014.01.001
- Tran, B. (2009). Green Management: The reality of Being Green in Business. *Journal of Economics, Finance and Administrative Science*, 14(27), 21–45.
- Uygur, A., Musluk, B., & Ilbey, N. (2015). Examining the Influence of Green Management on Operation Functions: Case of a Business. *Research. Journal of Business and Management*, 2(3), 348–365.
- Walker, H., Seuring, S., Sarkis, J., & Klassen, R. (2014). Sustainable Operations Management. *International Journal of Operations & Production*.
- White, L., & Lee, G. (2009). Operational research and sustainable development: Tackling the social dimension. *European Journal of Operational Research*, 193(3), 683–682.
- Whiting, B. (2021). *Green Management: Cost Effectiveness and Benefits*. Retrieved from <https://study.com/academy/lesson/green-management-cost-effectiveness-benefits.html>
- Zijp, M., Heijungs, R., van der Voet, E., van de Meent, D., Huijbregts, M., Hollander, A., & Posthuma, L. (2015). An Identification Key for Selecting Methods for Sustainability Assessments. *Sustainability*, 7(3), 2490–2512. doi:10.3390/u7032490
- Zubair, S., & Khan, M. (2019). Sustainable development: The role of green HRM. *International Journal of Research in Human Resource Management*, 2(1), 1–6.

Chapter 10

Human Resource Development's Role in Communicating the Risk of Climate Change and Promoting Pro-Environmental Behavioural Changes

Kiosha Ramlachan

University of KwaZulu-Natal, South Africa

Andrisha Beharry Ramraj

University of KwaZulu-Natal, South Africa

ABSTRACT

The notion of climate change has been identified and described as one of the foremost pressing environmental challenges of the current century. A large portion of credible scientists have agreed that climate change threatens irreversible and dangerous consequences on the earth's ecosystem as a whole. The mitigation of these potential consequences and impacts demands immediate, significant, as well as sustained changes and actions. Given the importance of the above, it is promising that various human resource development (HRD) researchers have taken an eager interest and fascination in environmental issues as well as sustainability.

INTRODUCTION

Worldwide the well-being of people is significantly threatened by the risks of climate change and the events of extreme weather has recently highlighted that the magnitude of these risks is uncomfortably high already (Holland & Young, 2020). Globally, climate change risks are well documented and promises of

DOI: 10.4018/978-1-7998-7967-1.ch010

Human Resource Development's Role in Communicating the Risk of Climate Change

action have been made by no less than 190 countries that signed the 2015 Paris Agreement (Holland & Young, 2020). The aim of the Paris Agreement amongst other things was to strengthen the response to climate change threats by the global world in an effort to eradicate poverty and ensure sustainable development (Paris Agreement, 2015). Even though drastic and significant changes have been taking place in the field of human resource (HR) functions over the past years, compliance to the climate change policies has now become an integral part of human resource development (HRD) policies. Incorporating climate change policies in HRD policies for global businesses has become so crucial for the global economy.

Climate change is anthropogenic in nature and origin and must be considered as real. According to the United Nations (2019), climate change threatens irreversible and dangerous consequences on the earth-system as a whole. The Intergovernmental Panel on Climate Change Fifth Assessment Report (IPCC AR5) (2014) asserted that the impacts are currently being felt and experienced effectively in the weakest human networks and ecosystems. Alleviating serious, unavoidable and irreversible impacts of climate change on individuals as well as ecosystems demands swift, significant and continued decreases in ozone depleting substance discharges (greenhouse gas discharges) (IPCC AR5, 2014). Given the importance of the above, it is promising that various HRD researchers such as Garavan and McGuire (2010), Scully-Russ (2012) and McGuire (2010) have taken an eager interest and fascination in environmental-related issues as well as sustainability. Therefore, in light of the above, the main aim of this chapter is exploring the role of HRD in communicating the risk of climate change and promoting pro-environmental behavioural changes at individual and organisational level.

CLIMATE CHANGE

It is a council of perfection that across the globe temperatures have become warmer and warmer over the years (Girvetz, Rosenstock & Nowak, 2019). Worldwide, the well-being of people is significantly threatened by the risks of climate change and the recent events of extreme weather have highlighted that the magnitude of these risks is uncomfortably high already (Holland & Young, 2020). Globally, climate change risks are well documented and promises of action have been made by no less than 190 countries that signed the 2015 Paris Agreement (Holland & Young, 2020). The Paris Agreement (COP21) is legally binding but voluntarily pledged (Clementon, 2016). The aim of the Paris Agreement amongst other things was to strengthen the response to the climate change threats by the global world in an effort to eradicate poverty and ensure sustainable development. The agreement had targets to pursue all efforts limiting the temperature increase to 1.5 degrees celcius and the long-term objective to ensure that by 2060 to 2080 there are zero-emissions in the world (Clemencon, 2016).

Initially the US had committed that by 2025 it would have reduced the greenhouse gas emission levels from 26% to 28% and from 2005 levels of which 80% of that gas emission reduction would have been energy related (Clemencon, 2016). China vowed that by 2030 it would have reduced its economic carbon intensity from 60% to 65% and from 2005 levels (Clementon, 2016). India committed a 33% to 35% reduction of its GDP emission intensity from 2005 levels by 2030 (Clemencon, 2016). Unfortunately, the Trump administration in 2020 pulled out of this historic agreement signed by former U.S. present Barack Obama in 2015, claiming that the agreement was forcing U.S. to curb carbon emissions, while placing few restrictions on China and India, therefore, the agreement was unfair (Bacon, 2020). Fortunately for the world, Joe Biden vowed to change that immediately if he wins the U.S. election, which he did in November 2020 (Bacon, 2020).

In Africa, climate change started in 1975 where temperatures started to increase at an annual rate of about 0.03 degrees celcius (Girvetz et al., 2019). Evidently, in South Africa there is a rapid and increasing escalation of the impact of changes in climate change (Chersich & Wright, 2019). By 2100, temperatures may rise by up to 4 degrees celcius in the Southern African interior and by over 6 degrees celcius in northern, central and western parts of the country if no action is taken to reduce greenhouse gas emissions (Chersich & Wright, 2019). In section 24(b) of the country's constitution, it places the obligation on all three spheres of government to ensure that environmental rights are protected by means of reasonable legislations and other measures to ensure sustainable development (Van der Bank & Karsten, 2020). Slowing down climate change is a challenge for many countries, and this relates to business operations. Therefore, it is estimated that by 2030 only seven countries outside the European Union and 28 nations in the European Union will reduce emissions by at least 40 percent (Watson, McCarthy, Canziani, Nakicenovic & Hisas, 2019). This means that many countries will still be polluting the world, and some will have very insignificant reduction contribution in combating climate change by 2030.

However, even though these above different developments are welcome, the current circumstances are challenging for HRD scholars, professionals and researchers in any event for two reasons. Firstly, the urging for green HRD as well as green human resource management (HRM) forefront the demand for environmental educational programmes, for instance, green administration modules and building up workers' environmental information base (McGuire, 2010; Renwick, Redman & Maguire, 2013).

CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT GOAL 13

In 2015, the United Nations (UN) announced and declared the 2030 agenda for sustainable development (United Nations (UN), 2015). Moreover, within this agenda was the creation of the 17 Sustainable Development Goals (SDGs) and their 169 associated objectives which are indivisible and integrated (UN, 2015) (Refer to Figure 1 below). According to Morton, Pencheon and Squires (2017), "the SDGs are a set of global goals for fair and sustainable health at every level: from planetary biosphere to local community" (p.1). The main objective is to eradicate poverty, to provide protection to the plane and make sure that every individual enjoys prosperity and peace, currently as well as in the future.

Among these 17 SDGs and pertinent to this paper, is the SDG 13. SDG 13 relates to taking immediate action to fight against climate change and its resulting impacts. Furthermore, under SDG 13 there are 5 further objectives (Refer to Figure 2 below). As mentioned above, SDG 13 and its associated objectives are indivisible and integrated. Climate change undermines a large number of humankind's greatest accomplishments along with their future goals as reflected in the 2030 Agenda for Sustainable Development (UN, 2019). Furthermore, the progress relating to SDG 13 is missing the mark, and ultimately falling short in terms of what is required to meet the objectives of the global goals by 2030.

As per the World Meteorological Organization (WMO) (2019), the years 2015 to 2018 were confirmed and declared the four hottest years on the planet, with this trend confirmed to be continuing. The world keeps on encountering rising ocean levels, outrageous climate conditions and expanding convergences of greenhouse gas substances (WMO, 2019). Climate change is an immediate and imminent threat and a crosscutting danger to the accomplishment of the agenda set out by UN (UN, 2019). Further to this, it is also a danger to the well-being and survival of coastal communities and island nations. This calls for dire and sped up activity by nations as they carry out and put in place the 2030 Sustainable Development agenda for 2030 and their responsibilities to the Paris Agreement on Climate Change (UN, 2019).

Human Resource Development's Role in Communicating the Risk of Climate Change

Moreover, climate change activity demands endeavors on adaption, mitigation, and methods for execution – capacity building, climate finance, innovation, and technology.

Figure 1. The United Nation's 17 sustainable development goals

Source: Morton et al. (2017)



Figure 2. Sustainable development goal 13

Source: PricewaterhouseCoopers (PWC), 2016

	Goal 13. Take urgent action to combat climate change and its impacts*
	13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries
	13.2 Integrate climate change measures into national policies, strategies and planning
	13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
	<hr/> 13.a Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly \$100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible
	13.b Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries, including focusing on women, youth and local and marginalized communities

Due to the adoption in 2015 of both the Paris agreement and the 2030 Plan, the closely linked connection between the two plans brought climate change to the forefront (UN, 2019). As such, this presents the greatest chance to bring about positive, foundational, and systemic change. With such change guaranteeing resilient societies, healthy environments, and productive economy for both current and also, future generations (UN, 2019). With the conclusion of the Paris Arrangement rule book at the climate summit (COP24) in Poland in December 2018, the world has entered an emergent time of improving ambition to execute and carry out climate change activity towards arriving at the worldwide goal of restricting global warming to 1.5°C above pre-industrial standards (UN, 2019). This includes through newly updated nationally determined contributions (NDCs) by 2020, and by up scaling climate change activities towards both mitigation and adaptation.

Synergistic execution is imperative. Accomplishing any remaining SDGs will be significantly more challenging without earnest climate change activity (UN, 2019). Such as those associated with hunger, poverty water access, marine and terrestrial biological systems, gender equality, health and lastly, women and girl empowerment, among others. Conversely, a large number of the objectives and targets can likewise be accomplished in manners that would allow adaptive reactions to climate change (UN, 2019). The energy advances conceived in SDG 7 would contribute altogether to bringing down ozone depleting substance such as greenhouse gas discharges comparative with business-as-usual pathways (UN, 2019). In a similar way, increased sustainable industrialization found in SD 9, sustainable sustenance production frameworks and strong and flexible agricultural processes under SD 2, and modifying production and consumption patterns in correspondence with SDG 12, can effectively contribute to lowered-emission pathways, the development of emergent types of jobs and lastly, longer term progress in terms of eradicating and alleviating poverty as well as other deprivation (UN, 2019). In addition to this, it is well-known that organizations have been a huge contributing factor to the state of climate change the world finds itself facing (Renwick et al., 2013). Due to this, it only makes sense that organization take a key role in trying to curb the impact of climate and is a part of this synergistic execution. Specifically, promoting behaviours that are favourable to the environment. In an organization context, this has fallen to the functions of HRM and HRD to serve as change agents and lead this challenge. As such, climate change and HRM will be discussed next.

CLIMATE CHANGE AND HUMAN RESOURCE MANAGEMENT

Companies and countries must achieve socio-ecological transition in a global fight against climate change (IBA Global Employment Institute, 2017). Furthermore, the employment and climate change relationship is a relatively new phenomenon in the world of work, and it will have ramifications and implications for the future generation of employees. Therefore, organisations and countries need to design employment policies, training and other necessary initiatives to ensure smooth transition to green employment, according to the International Labour Organization (ILO) (IBA Global Employment Institute, 2017). In businesses where human resources play a crucial role in going green at the office, green HRM is key to business strategies (Ahmad, 2015).

Furthermore, an issue in planning formal learning initiatives that intend to achieve favourable environmental behaviour changes is that challenges within the environment as well as the manner in which they appear are distinctive in the type and extent of a lot of the conventional organisational and individual performance issues and problems that HRM as well as HRD are regularly approached to address (Renwick

et al., 2013). Indeed, in spite of the fact that it is totally feasible to create and put in place initiatives and interventions which enhance the environmental information base and core of workers, such endeavours will probably be inadequate, ineffective, and perhaps futile. However, the aforementioned does not need to be the case if they are done in such a manner that leads to critical changes in perspectives about the risks to the environment and to favourable environmental behavioural practices in organisations as well as the more extensive community (Renwick et al., 2013).

The socio-environmental framework is adaptive, holistic and complex. A further issue is to attempt to guarantee that various analysis levels and the demand for systemic reasoning are most certainly not disregarded or overlooked (Scully-Russ, 2015; Senge, 1997; Senge, Carstedt & Porter, 2001). As McGuire (2010) contended in his supplication for the installing of environmental awareness and an awareness of others' expectations for one's activities throughout all organisational levels in an environmental and corporate consciousness. It is crucial that the departmental and individual levels are recognised in green HRD. There are persuading theoretical explanations for this statement. Worker-friendly environmental behaviour changes are facilitated by a culture in an organisation within which the individual worker is found (Sadler-Smith, 2015). However, by a similar token, individual workers' behaviours, specifically those of managers and leaders, form the culture wherein favourable environmental behaviours may prosper. Therefore, consideration of employee wellness in all spheres of industrial revolution is crucial because it is an important aspect of HRM systems (Beharry-Ramraj & Amolo, 2020). Similarly, organisational cultures and structures have the ability to constrain individual employee's favourable environmental behaviours (Sadler-Smith, 2015). Moreover, in the same light, Giddens (2011) states that individual employee's behaviours have the ability to reproduce organisational cultures and structures that are contradictory to sustainability in the environment.

UNDERSTANDING THE NEED FOR THE SHIFT FROM TRADITIONAL HRD TO GREEN HRD

According to Munasinghe (2002), during the last three decades, governments around the world have aimed to shape the economic perspective whereby development should be more sustainable. This view was aimed at achieving optimal and effective economic outcomes in relation to the sustainable usage of the planet's limited natural resources. If organisations globally are to transform into becoming sustainable, it is imperative that HRD undertakes a critical role. Ulrich (1997) and Swanson (1998) state this due to the fact that it is generally accepted that HRD is positively correlated with organisational results performance including organisational financial advantages.

It is broadly recognised and understood that organisations have and will continue to play a critical role in the degradation of the earth's environment (Kwong, 2005). The aforementioned factors make it evident that the actions of organisations have become the subject of intense public and regulatory scrutiny (Khanna, Heng & Chia, 2010). However, Delmas and Toffel (2004) state there is no sight of a consensus regarding how HRD can play a key role in transforming organisations into greener organisations to avoid further risks such as the general public rejection and or government fines which can adversely affect their finances.

The mainstream perspective on HRD refers to it being established to provide expertise and competencies to the organisation (Swanson, 1998). The majority of traditional HRD theories have concentrated on increasing return on investment (ROI) as well as cost effectiveness of an organisation (Swanson,

1998; Wang, Dou & Li, 2002; Dewhurst & Guthridge, 2009). However, recent organisational HRD imperatives include reducing costs and effectively balancing both long- and short-term performance (Milstein, Hart & York, 2002). Previous theories have created a link between organisational outcomes and staffing practices (Ulrich, 1997). Therefore, HRD is currently faced with the challenge of continuously providing economic and financial support to their organisations by way of the greening of HRD. As such, Haddock, Jeffrey, Miles, Muller-Camen and Hartog (2010) assert that HRD needs to go further than a combination of training, development, organisational development and career development in order to enhance an organisation's and employee's environmental effectiveness. Thus, this necessitates the shift of traditional HRD which was based on a ROI paradigm to that of green HRD. In light of the above, Haddock et al. (2010) define green HRD as "a cyclic process of continuous development and transformation of self, others and the organisation, as prudent users of natural and manmade resources, aligning economic, environmental and social growth, for present and future generations" (2010, p.3).

BENEFITS OF GREEN HUMAN RESOURCE MANAGEMENT AT ORGANISATIONAL AND INDIVIDUAL LEVEL

According to Crotty and Rodgers (2012) and Obediat, Al Bakri and Elbanna (2018), several studies relating to green HRD/HRM have delivered evidence for the substantial impact at organisational level relating to performance such as financial and environmental performance and at individual level relating to employee outcomes. Therefore, bettering work climate as well as meeting emergent work demands and requirements of the 21st century regarding environmental awareness and climate change benefit both employees and the organisation.

Benefits of Green HRD/HRM at Individual Level (Employees)

According to Chan and Hawkins (2012), not only is green HRD/HRM a key strategic plan to improve environmental behaviour of an organisation but it also assumes a key role in improving employee outcomes. Yusoff, Nejati, Kee and Amran (2018) state that research indicates that a worker's assessment of their respective job characteristics is a critical aspect that influences employee working behaviour. Arnett, Laverie and McLane (2002) state that many job characteristics such as recognition, fairness, the work itself, pride, self-actualisation, participation, working conditions and advancement can impact the manner in which employees view their job and can ultimately lead to their satisfaction. This can be understood from the viewpoint of the theory of job characteristics, which determines task identity, skill variety, task significance, autonomy as well as feedback as central job characteristics. This can elicit varying psychological states within an individual (Hackman & Oldham, 1976). Additionally, pride, recognition and participation encourage work meaningfulness, feedback encourages work outcome and understanding, and autonomy facilitate work outcome responsibility (Hackman & Oldham, 1976). In addition, the job characteristics mixture enhances the motivational factors of a position resulting in positive employee outcomes like quality performance and job satisfaction (Hackman & Oldham, 1976). According to Pollock, Whitbred and Contractor (2000), job characteristic evaluation and perceptions of employees can impact their satisfaction and attitudes. This means that when workers view that their position holds every central characteristic, they view their position as creating meaning for them, thus leading to increased job satisfaction.

Kim et al. (2019) and Paille et al. (2014) state that green HRD/HRM is an instrumental strategy that assists organisations in achieving environmental objectives through creating and implementing a green environment culture as well as green workers who show concern for environmental issues. Chan and Hawkins (2010) state that even though engaging environmental protection increases employee workload, it is still a notable objective for organisations and organisations must still continue to concentrate on the environment. The above is in line with green HRD/HRM objectives to value the protection of the environment by concentrating on activities which decrease adverse impacts and increase positive impacts on the environment. Notably, in a situation where workers consist of environmental awareness in which they engage in planet protection and contribute to an improved, safer and healthier environment, they view they are delivering something positive toward the environment (Chan & Hawkins, 2010). Moreover, by highlighting shared environmental values and goals, green HRD/HRM encourages an environment whereby both employers and employees feel something meaningful is being done by them. As such, Chan and Hawkins (2010) state that this will result in creating a feeling of meaningfulness achieved through their work and can ultimately led to job satisfaction.

Specifically, green HRD/HRM promotes task identity, task significance and skill variety through delivering shared environmental goals and vision and providing training to improve workers' environmental awareness (Shafaei, Nejati & Yusoff, 2020). Additionally, by empowering and encouraging employees to share their environmental objectives, employees are of the viewpoint that they possess autonomy in performing environmental activities. Furthermore, through the evaluation, recognition as well as rewarding of employees' environment performance, employees can recognise the actual effect of their activities (Shaefaei et al., 2020). Therefore, green HRD/HRM, by delivering central employee job characteristics, assists employees in improving their respective work behaviours.

Benefits of Green HRD/HRM at Organisational Level

Combs, Liu, Hall and Ketchen (2006) state that HRM is critical to improving an organisation's competitive advantage. Furthermore, O'Donohue and Torugsa (2016) assert that it is clear in literature that organisations are actively putting in place practices to improve management of the environment with decreased costs as well as higher flows of revenue, to achieve salient environmentally associated organisational objectives. Sudin (2011) states that research indicates that green HRD/HRM is seen to be among some of the most ideal strategies for enhancing an organisation's environmental performance as this delivers a critical basis to efficiently handle and deal with an organisation's environmental impact. Paille, Chen, Boiral and Jin (2014) and Roscoe, Subramanian, Jabbour and Chong (2019) state that environmental performance pertains to organisational commitment to environmental protection and displaying environmental care by way of creating and outlining measurable operating parameters. As such, practices of green HRM such as environmentally friendly HRD/HRM initiatives result in higher efficiencies, decreased costs and enhanced employee retention and engagement. According to Sheopuri and Sheopuri (2015), ultimately, this will benefit and be advantageous to organisations through the dampening of employees' carbon footprint. Furthermore, Fayyazi, Shahbazmoradi, Afshar and Shahbazmoradi (2015) state that green HRD/HRM assists organisations in improving their environmental performance by way of improving employee awareness related to environmental challenges and issues.

Similarly, Dutta (2012) holds that an ideal manner for organisations to attain better environmental performance is through green HRD/HRM as it provides the 'green employee' by concentrating on green training, hiring as well as compensation. Daily, Bishop and Govindarajulu (2009) and Kim, Kim,

Choi and Phetvaroon (2019) state that workers are organisational building blocks, and their favourable environmental behaviours result in the improvement of environmental performance of an organisation in aggregate. Furthermore, previous research supports the concept that greening of HRD/HRM creates a surrounding, whereby green activities as well as initiatives are deemed as shared employee values. Furthermore, this may result in green empowerment, the facilitation of organisational environmental performance, higher sustainability management engagement as well as bettering green supply chain activities (Gholami, Rezaei, Saman, Sharif & Zakuan, 2016; Nejati, Rabiei & Jabbour, 2017; Teixeira, Jabbour, de Sousa Jabbour, Latan & De Oliveira, 2016).

Practices of green HRD/HRM are viewed as helpful organisational strategies to better human capital that can ultimately result in enhanced environmental performance by way of promoting workers' green behaviours and facilitating a green culture within the organisation (Alvarez Jaramillo, Zарtha Sossa & Orozco Mendoza, 2019, Roscoe et al., 2019, Kim et al., 2019). Arda, Bayraktar and Tatoglu (2019) and Paillie et al. (2014) state that there is a considerable amount of research delivering evidence highlighting the key role of green HRD/HRM in acquiring environmental sustainability. Daily, Bishop and Masoud (2012) focused on various employee levels such as group, individual, system and organisation and workplace green initiatives. The salience of organisational learning and environmental training and their association to environmental performance was explored in a study carried out by Vidal-Salazar, Cordon-Pozo and Ferron-Vilchez (2012). According to O'Donohue and Torugsa (2016), Paille et al. (2014) and Tariq, Jan and Ahmad (2016), there is an understanding that workers who possess environmental values play an important part in assisting organisations in actively embracing and accepting environmental sustainability principles and enhancing environmental performance of an organisation.

FINANCIAL IMPACT OF CLIMATE CHANGE ON HUMAN RESOURCE DEVELOPMENT AND ORGANISATIONAL PERFORMANCE

Organisations usually view the ecosystem as a separate aspect to that of the economic environment (Secinaro, Brescia, Calandra & Saiti, 2020). Although Moyo and Wingard (2015) state that climate change is able to shift an area's economic development pattern as well as comparative advantage, this indirect impact owing to climate change on organisations encourages them to welcome climate change mitigation programmes put in place by non-governmental institutions, other creative stakeholders and consumers (Moyo & Wingard, 2015). Giannarakis Zafeiriou, Arabatzis and Partalidou (2018) state that improved environmental behaviour positively impacts the level of disclosure relating to climate change. Soyka (2012) conducted a recent study which provided a perspective relating to the correlation among sustainability and financial returns, specifically with regards to lower cost of debt and equity. Various scientific contributions such as Bae and Sami (2005), Hsu and Wang (2013) and Stern (2014) identified a positive association between disclosures relating to climate change and financial performance. Moreover, such studies also revealed that these organisations' market performance is far superior in comparison to organisations with negative environment information.

Elfeky (2017) states that apart from the economies of scales, the agency, legitimacy and stakeholder theories underpin the relationship that exists between organisational size and disclosure relating to climate change. Suchman (1995) defines legitimacy theory as a "generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs" (p. 574), while Wood (1991) states stakeholders are "those groups or individuals

that could affect, or are affected by, the accomplishment of organizational purpose” (p. 25). Secinaro et al. (2020) asserted through demonstration that legitimacy theory is related to the disclosure level of the aspects associated with environmental sustainability. The authors’ statistical analysis identified that a modification in an organisation’s reporting behaviour impacts their legitimacy with a sustainability disclosure that is high in quality enhancing the organisation’s credibility with their stakeholders. According to Jensen (1994) and Shi, Magnan and Kim (2012), alternate studies relating to agency theory that takes into account the relationship among organisations, managers, state and stakeholders state that a decrease in costs associated with the development of reports relating to sustainability permits a decrease in agency costs as well as conflict among actors, therefore enhancing market and stakeholder confidence. As such, Gray (2006) states that these two theories lead to the demand for reports relating to environmental sustainability from a longer-term viewpoint.

According to Owusu and Asumadu-Sarkodie (2016), the costs related to the mitigation against climate change has a substantial impact on the operational costs of organisations in critical aspects, including supply chain, production and energy costs. Furthermore, operational costs are impacted due to mitigation measures relating to climate change calling for a decrease in carbon emissions and environmental impact. Additionally, initiatives to decrease carbon emissions are associated with cost-cutting structures and seeking alternate sources of efficient energy (Owusu & Asumadu-Sarkodie, 2016). Moreover, costs associated with climate change mitigation involve HRM initiatives and programmes and reassessing an organisation’s logistics. Owusu and Asumadu-Sarkodie (2016) state that due to the fact that energy cost is related to climate change, a decrease in renewable energy prices is anticipated to lower and set off an increase in an organisation’s supply to transcend the carbon fuels. According to Bisbis, Gruda and Blanke (2018), a further element associated with the cost of energy is production cost. There is a variation relating to the socio-environmental cost among sustainable and unsustainable production. It is possible for the socio-economic cost to be concealed by way of externalities. As such, it is critical to substantially enhance efficiencies through utilising advanced technology and enhancing and bettering resource utilisation.

According to Hecht (2007) and Kunreuther and Michel-Kerjan (2007), specific risk elements are directly associated with climate change affecting an organisation’s financial performance and position. These include the shutting down of plants because of pollution, facilities flooding and water constraints, to name a few. While most organisations will be protected from the physical dangers related to climate change by way of insurance, it is clear that emergent types of risks increase organisations’ risk exposure (Secinaro et al., 2020). Furthermore, the rapid transformation of an organisation to strategies that are climate-related has developed an impetus toward innovation and the driving of capital toward assets that are carbon intensive. On the other hand, Bayon, Hawn and Hamilton (2012) state that certain assets have become redundant in certain business models resulting in substantial insolvencies and financial losses. According to Arslan-Ayaydin and Thewissen (2016) and Zhang and Chen (2017), various scholars have assessed whether there are financial perks for enhancing and bettering environmental performance. A credible reasoning is that investment into the natural environment will come at an expense to an organisation as it may take away from the maximization of profit (Secinaro et al., 2020).

According to Schaltegger and Synnestvedt (2002), studies have noted that better performance has led to increased sales and cost savings. Soyka (2012) and Teoh, Pin, Joo and Ling, (1998) state that most empirical study efforts have indicated that there is indeed a positive relationship that exists among enhanced environmental and financial performance. However, there is only a small amount of framework or evidence on when and what environmental investments are advantageous to an organisation (He, 2016).

Muthulingam, Corbett, Benartzi and Oppenheim (2013) state that motivated and driven environmental strategies can be seen as tangible, although most organisations are not the ones to initiate or start these strategies, therefore suggesting that corporate resistance exists. McGuire, Sundgren and Schneeweis (1988) state existing literature utilises either market-based or accounting measures relating to financial performance as interchangeable. Furthermore, on one hand, accounting measures are utilised to assess initiatives which have consequences for the organisation within the shorter-term period like decreasing operational costs, while market-based valuation is principally based on the perceptions of investors regarding the estimated profitability of an organisation (McGuire et al., 1988).

THE ROLE OF THE HRD IN COMMUNICATING THE RISK OF CLIMATE CHANGE AND PROMOTING FAVOURABLE ENVIRONMENTAL BEHAVIOURAL CHANGES AT ORGANISATIONAL AND INDIVIDUAL LEVEL

According to Pidgeon (2012), it is highly unlikely that countries will be equipped to suppress and/or restrict emissions to a significant degree unaccompanied by fundamental modifications related to human behaviour. However, a major barrier to enabling essential and far-reaching favourable environmental behaviour change does not specifically have to be a lack of concern or public recognition (Pidgeon, 2012). Individuals are overwhelmed by stories relating to climate in the media every day and various individuals are acknowledging and realising the problem. For instance, the outcomes of a web survey which consisted of over 1,000 members of the public in the United Kingdom in the spring of 2015 showed the following three agreement levels (Harvey, 2015). Firstly, the climate globally is modifying (81% agreement), increasing global temperature is due to emissions that are man-made (76% agreement) and lastly, climate change poses a serious danger to international stability over the coming 50 years (72% agreement) (Harvey, 2015).

Problem awareness solely may not be the biggest challenge. An increasingly important barrier is the distance psychologically from climate change consequences. Due to the fact that the impacts of present behaviours are viewed as distant spatially and temporarily indicates that the expectation that individuals will respond to climate change now may not appeal to them. Furthermore, this is further exacerbated by the fact that significant changes and immediate action in modifications to their lifestyles in the exchange for the promise of rewards are very far away, that is, after life and are unknown in nature (Spence, Poortinga & Pidgeon, 2012). In line with this, the IPCC AR5 (2014) states that climate change is not just a scientific problem, but a fundamental behavioural and psychological issue that arises from people's perceptions of risks and the manner in which people consider information regarding the possible impacts of climate taking into consideration their lifestyle and behavioural decisions. As such, in light of the above and if climate change does relate to individual development and learning, then HRD needs to contribute to improving the psychological distance described above.

Following this, the next area in which HRD assists in communicating the risk of climate change and promoting favourable environmental behavioural changes is at organisational level. Climate change relates to the values which organisations view as important. Values within an organisation serve as a compass, particularly a moral compass, for the manner in which business is carried out. Therefore, if organisational values are critical, then deciphering values and their meaning in practice also becomes critical. However, the issue of whether these values translate into the way the organisation really conducts itself is hard to tell. An alternative may be to inquire which virtues determine behaviour rather than which

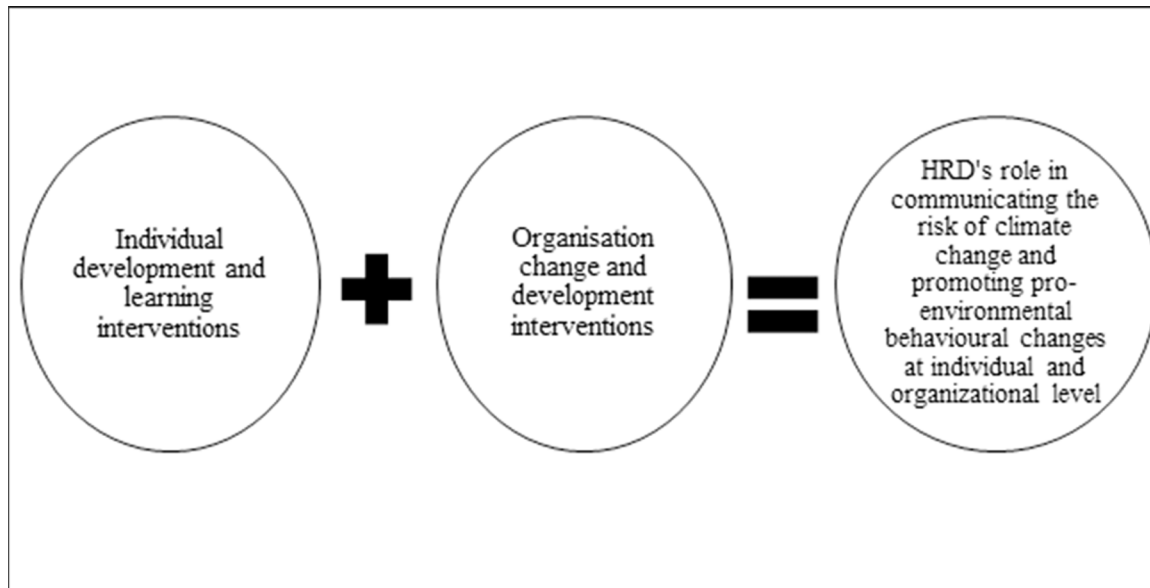
values. Relevant developments exist regarding ethics in business, organisational behaviour and positive organisational science (POS) that can assist in finding answers to this dilemma (Sadler-Smith, 2015). According to Cameron (2003) and Cameron and Roshan and Kazah (2004), research relating to POS has broadened Aristotle's virtue concept to the organisation itself from an individual moral figure. As such, Cameron (2003) and Cameron et al. (2004) state that organisational excellence and virtuousness is based on moral goodness, unrestricted social betterment and human influence. Virtuousness habituates and predisposes the organisation toward being an ethical self-organisation and a morally self-regulating organisation in a manner that is consistent with that of basic virtuous ethical principles. At the same time, organisational behavioural experts have also created a concept relating to positive deviance. According to Spreitzer and Sonenshein (2004), in an organisation this is referred to as "intentional behaviour that departs from the norms of a referent group in honorable ways and has evaluative (ought to occur), atypical (in relation to a referent group as represented by industry norms) and intentional (honorable intentions irrespective of outcomes) components" (p. 8). As such, positive deviance and virtuousness within organisations are compatible conceptually.

Sadler-Smith (2013) proposed this line of reasoning and related it to issues in the environment by proposing the idea of organisational environmental virtue (OEV). OEV is defined as "a collective ethical disposition which habitually motivates, guides and corrects moral behaviour in organisations in positively deviant ways that contribute to environmental sustainability" (Sadler-Smith, 2013, p. 124). Walls and Hoffman (2013) state that attaining positive deviations in favourable environmental behaviour requires organisational environmental practices and policies that are beyond minimum standards, move away from other organisations within the field as well as provide wide social benefits. Moreover, due to the scale and nature relating to climate issues, two things are needed in order for influence that moves beyond a once-off environmental initiative and/or cause (Sadler-Smith, 2015). Firstly, having moral conviction which converts into a positive deviation instead of adherence to minimum ethics and moral norms (Sadler-Smith, 2015) and secondly, a virtuousness which is accustomed to the organisation's moral character. Attaining a dispositional state in which environment virtuousness will be allowed to prosper within an organisation in a positively deviant manner is likely to include organisational change and development, possibly to the degree of transformational change.

A two-dimensional, system-wide approach between the individual and the organisation is far more effective than just concentrating on the organisation or individual in isolation (Sadler-Smith, 2015). HRD consists of a distinguishable opportunity in which HRD may have an influence (Refer to Figure 3 below). Firstly, through individual development and learning intervention whereby psychological distance of the issue as well as the consequences are decreased to impact behavioural and attitudinal changes. Secondly, through organisational change and development interventions that promote and encourage positive organisational environmental deviance and organisational transformation.

Figure 3. A two-dimensional, system-wide approach involving HRD's role in communicating the risk of climate change and promoting pro-environmental behavioural changes at individual and organisational level

Source: (Sadler-Smith, 2015)



Individual Level

According to Hoffman (2010), every effort in an attempt to deal with climate change should start with learning. Although Hoffman (2010) states the above, the author also bemoans the shortage of literacy relating to environmental challenges. The accuracy and extent relating to public knowledge regarding the science of climate change varies both internationally and nationally. For instance, Harvey (2015) states that a current UK poll also discussed above indicated a high level of agreement regarding the nature, causes and extent of the issue. While contrastingly, the Yale Climate Change Communication Project indicated that only a mere 41% of the public in the United States of America (USA) are of the belief that climate change is indeed occurring and is caused by human activities (Marlon, Leiserowitz & Feinberg, 2013). The study further identified that a third of the US public believe there are various disagreements that exist among some scientists regarding whether global warming is occurring or not (Marlon et al., 2013).

To make matters worse, climate change sceptics and deniers have done their best to convince the public that these risks have been greatly exaggerated. The UK created an impressive foundation relating to Global Warming Policy which includes several high-profile individuals such as Margaret Thatcher and Nigel Lawson, the self-proclaimed natural sceptic (The Global Warming Policy Foundation, 2020). The foundation claims to have an open mind regarding the controversial science relating to global warming as well as being greatly concerned about the cost involved as well as other consequences of the various climate change procedures and policies now being promoted and encouraged (The Global Warming Policy Foundation, 2020). However, according to Pidgeon (2012), alarmingly specific researchers have noted an increase relating to media interest as well as an associated decline in public concerns regarding

Human Resource Development's Role in Communicating the Risk of Climate Change

climate change as such, this may be due to climate change being displaced by more pressing concerns such as the economic crisis of 2008, fatigue and information overload and high-profile individuals who are climate change sceptics and deniers engaging in the de-risking of the issue (Pidgeon, 2012). In the year, 2014, the Guardian, a UK newspaper, stated it was easier to include Republicans in the American Congress who believe climate change is genuine than to include Republicans who do not, as there are very few individuals who are part of the former group (McCarthy, 2014). Furthermore, in this article, McCarthy (2014) stated that the Senator of Oklahoma, Jim Inhof, who is a high-ranking individual of the Senate public works and environment committee that reviews American environmental policy as well as directs and controls the Environmental Protection Agency, asserted that climate change is seen as one of the biggest hoaxes ever committed against the people of America. Attempts to influence people's understanding and knowledge are met by a wave of high-profile climate change sceptics and deniers who expend much effort into influencing the perceptions of the public and to counteract accepted scientific opinion.

Meeting the challenge of development and learning demands risk communication that is effective. Drawing attention to a small number of salient facts might be better than bombarding individuals with emergent and possibly overwhelming information (Reynolds, Bostrom, Read & Morgan, 2010). However, irrespective of the fact that important information is delivered in a focused manner such as through the media and that the adopted concern levels regarding climate change are high, various individuals still tend not to behave sustainably (Spence et al., 2012). The reason for this can be discovered by taking into account the seemingly mysterious concept matter relating to weather versus climate (Spence et al., 2012). A study carried out by Reynolds et al. (2010) consisting of individuals living in the north east of America indicated that a substantial proportion (40%) of individuals agreed with the false statement which stated that the weather is an average climate. The opposite holds true. The meaning of this misconception is salient as it is totally feasible to have an excessively cold winter in a general trend of rising average temperatures globally (Reynolds et al., 2010), while, on the other hand, encountering first-hand an extreme winter event due to climate change is viewed as counter intuitive with regards to the idea of the warming planet (Reynolds et al., 2010). Additionally, the domestic experience regarding an out of the ordinary cold winter can cause confusion to people who are not specialists and results in them accepting the claims of deniers that global warming is, indeed, a myth. Moreover, this further highlights a more general challenge that will now be addressed.

The merging of climate and weather emphasises a critical component in encouraging and facilitating learning regarding climate change (Reynolds et al., 2010). In addition, the distance psychologically to climate change consequences are such that all learning which is meant for the mobilisation of favourable environmental behavioural changes requires concentration on the domestic implications for people, their communities and the more basic results that are more foregrounded. Weather is occurring in the present; it is real as well as psychologically proximal (Reynolds et al., 2010). Furthermore, climate is never directly experienced in the sense that people who are living in the moment always have weather. As such, climate is seen as both more abstract in comparison to weather and more psychologically distant. Therefore, the viewpoint of the climate change risks is also considered psychologically distant in three ways: space, time and goals (Reynolds et al., 2010). In other words, for various individuals great impacts will happen elsewhere (space), after their lifetimes (time) and affect other groups or individuals (goals).

Construal level theory developed by Liberman and Trope (2008) encapsulates the issue accurately. It states psychologically distant phenomena are cognitively represented by basic decontextualised features that make up an abstract high level of construals, while psychologically close phenomena are cognitively

represented by the details of a particular context which is made up of concrete lower-level construals (Spence et al., 2012). Objects that are temporally, socially and self-spatially removed are created at a higher abstract level (Liberman & Trope, 2008). In line with this, Giddens (2011) stated that the possible consequences of higher abstractness (higher construal level) relating to climate change effects could be identified in the next paradox. The threat presented by global warming is not visible, tangible or concrete during the daily activities of life for the majority of individuals (Giddens, 2011). As such, various numbers of these individuals will do nothing and not be proactive in reducing the dangers or threats of climate change effects. However, Giddens (2011) states that it should be noted that waiting for these threats and dangers to emerge and intensify in the form of catastrophes that are undeniably due to climate change prior to being pushed toward taking serious action will be too late.

Seabright (2010), in an associated discussion relating to moral sense making, asserted that strong affective reactions encourage increasing moral concern rather than calculated cold analysis. In keeping with this concept, Sadler-Smith (2014) argued that activation of favourable environmental behaviours and attitudes is reliant on whether concern through effectively charged and personally meaningful reactions will be mobilised or not. For instance, utilising compelling and vivid images that concentrate on shorter-term personal and local impacts relating to climate change as well as the negative effects on personal well-being and lifestyle may be more effective in mobilising favourable environmental behavioural changes rather than merely providing global-level figures and facts (Sadler-Smith, 2014). There is research which is in support of the viewpoint that proximity is seen as a key factor relating to risk communication. Scannell and Gifford (2013) studied the effectiveness of various strategies of communication in order to mobilise concern relating to climate change. The study found engagement in climate change to be larger in people who possess a strong place attachment to their local region, as well as that local communication framings enhanced success regarding the risk communication of adverse climate effects (Scannell & Gifford, 2013). As such, local communications are more likely to be increasingly effective in comparison to global communication (Scannell & Gifford, 2013). Lastly, Schnell and Gifford (2013) state that people with a strong attachment to the local regions, both social and affective, may be the best advocate for the initiation and promotion of favourable environmental behavioural changes.

According to Spence et al. (2012), without reducing psychological distance, the broad and long-term consequences and risks associated with global warming are detached and distant from reality as it is experienced by individuals. Due to this, individuals' responses to global warming are more likely limited to abstract, affective and distanced 'cold' intellectual discussions instead of concrete, affective and direct 'hot' behavioural responses (Spence et al., 2012). Therefore, Scannell and Gifford (2013) state that framing the problem in such a way that psychological distance is bridged, risks are rendered and that the consequences are real as well as local, is of vital importance.

In a related manner, Rojas Blanco (2006) maintained that closing the gap between the scientific community and local level is needed. This is due to the former's key concern being located at macro level while the latter's key concern is located at micro level. Appropriate scientific understanding and knowledge can be implemented in the local regions and mobilised into increasingly direct environmental initiatives close to home through interchanges between the scientific and local communities (Rojas Blanco, 2006). Moreover, such initiatives are more likely to become increasingly effective should they include stakeholder partnerships from government institutions, civil society and business organisations. It should be noted that these projects require intermediaries who are trained to facilitate individual change, development and learning skills which are well within the range of HRD practitioners and researchers.

In conclusion, the development and learning of the climate change issue at individual level demands a communication and bridging function (from international to domestic as well as abstract to concrete) whereby HRD, due to expertise in the facilitation of individual change, development and learning, is well positioned to carry out and fulfil. This may be attained in the following three ways. Firstly, by decreasing the overload of information by way of concentrating on important anthropogenic causes and the effects of human systems on climate change. Secondly, decreasing spatial, social and temporal factors relating to psychological distance through affect-laden, domestic cause and effect communication framings, and lastly, by supporting local level partnerships and coordinated social responses.

Organisational Level

While this paper has recognised the importance of individual development and learning, it is also critical to acknowledge the demand to stimulate and steer profound cultural change that can lead organisations towards favourable environmental behaviours towards the mitigation of climate change (Hoffman, 2010). Key HRD questions relating to their potential role in the above revolve around understanding which organisational cultural aspects are key, which of them require development and the manner in which this organisational change and development can be facilitated.

In terms of HRM, Renwick et al. (2013) called for the inclusion of “deeply embedded values which support long-term sustainability into organisational cultures.” (p. 7). In line with this, Fernández, Junquera and Ordiz (2003) argued that the successful application of an “advanced environmental approach demands a culture based on ecological values” (p. 641). Moreover, Borial (2009) was increasingly particular on the specifics in arguing that firstly, organisational citizenship behaviour (OCB), which is individual behaviour which is voluntary and not explicitly or directly acknowledged by a formalised reward system that can be applied or modified to the organisation’s environmental practices. Secondly, common OCBs of assisting, sportsmanship, organisational compliance, organisational loyalty, self-development and individual initiative can be related to environmental challenges. Borial (2009) also asserted that virtuous principles are what underpin these OCBs. However, he was less transparent on their ethical or moral philosophical basis.

At the same time, existing discussions relating to literature pertaining to green HRD regarding ethics roles and the demand to “promote an ethical culture/climate by focusing on positive values that shape the ethical beliefs and actions of employees” are very much on-going and relevant (Garavan & McGuire, 2010, p. 492). If, according to Garavan and McGuire (2010), ethical behaviour concentrates on problems of ‘bad’, ‘wrong’, ‘right’ and/or ‘good’, then leading theoretical concepts are required for delineating ‘right’ or ‘good’ behaviours and beliefs from those that are considered ‘wrong’ or ‘bad’. Appropriate models, theories and concepts stemming from POS and virtue ethics can supply HRD practitioners and researchers with a group of principles for taking action.

Traditional virtue ethics has its roots in Aristotle’s moral teaching, as found in his own Nicomachean ethics (Hutchinson, 1995). Moreover, Aristotle distinguishes intellectual and moral virtues. The former refers to the nature of the mind that enables one to know what is truth, wisdom, knowledge, and consciousness/intuition (Hutchinson, 1995). While the latter refers to the nature of one’s emotions that assists one in responding correctly to practical situations such as patience, courage, and temperance (Hutchinson, 1995). Both of these aspects of human nature converge around the intellectual virtue of practical knowledge, sophistication or prudence, whose function is to allow individuals to know the right way to behave as well as implement the right value orientation which is provided by moral virtues (Hutchinson,

1995). Moreover, according to moral philosophy authored by Aristotle, the best moral virtue achievable through human action is eudimonia, which refers to fulfilment, happiness or flourishing. Furthermore, Aristotle asserted that to be virtuous is seen as practical instead of an endeavour that is intellectual. In other words, it is through sustained habituation or performance of temperate, virtuous and just actions that individuals obtain virtues (Hutchinson, 1995). Additionally, moral philosophy authored by Aristotle is collective and is based on the term koinonia which refers to community, partnership or sharing. Lastly, Beadle and Moore (2006) and Hutchinson (1995) further state that it focuses on social betterment related to the need for living a virtuous life in the human community as well for the betterment of the community.

Virtue as a classical concept has been applicable to environmental challenges in the field of environmental virtue ethics (EVE). According to Sandler (2005), EVE defines virtue as “the proper dispositions or character traits for human beings to have regarding their interactions and relationships with the environment” (p. 3). Virtue is a question of moral behaviour and character. As such, the EVE perspectives highlight the care and protection relating to individual moral responsibility and goodness and moral conviction instead of the enforcement of behaviours which decrease harm or the demand of adherence to externally applied ethical expectations or behaviours. As such, Flinty and May (2000) state the way an organisation habitually and routinely treats the environment speaks to its organisational member’s moral characters and is displayed through its ethical climate. Additionally, O’Neill, Holland and Light (2008) add that those organisational members who possess and exercise power can eventually be held accountable for the organisation’s moral character in which they are the leading principal agents.

However, the inquiry into what moral climate and moral character of an organisation as well as what type of virtues may be relevant when an organisation wants to be environmentally virtuous still remain. Sadler-Smith (2013) provides around six possibly appropriate virtues derived from literature relating to EVE to form a preliminary list pertaining to OEVs. According to Stern, Dietz and Kalof (1993) and Wilson (1994), the first OEV is appreciation. This refers to a human being’s positive, value-loaded affective, behavioural and innate relationship to the biosphere (Stern et al., 1993; Kalof, 1993). Furthermore, Van Wensveen (2005) states attunement as the second appropriate OEV. This pertains to the adjustment of emotions and drives through eco-socially productive ways (Van Wensveen, 2005). Moreover, the third OEV is benevolence (Frasz, 2005). This involves the consistent and active concern relating to the well-being, interests, happiness, health and flourishing of both non-human and human others (Frasz, 2005). Additionally, the fourth OEV is endurance (Van Wensveen, 2005). This pertains to maintained eco-social participation while being faced with setbacks, temptations and challenges (Van Wensveen, 2005). In addition, the fifth OEV, according to Wenz (2005), is reciprocity. This concerns actions which move away from social norms toward an ideal inclination whereby people aspire for others and themselves, anticipate reciprocity as well as the far-reaching welcoming of and participating in these behaviours (Wenz, 2005). The last OEV is position (Van Wensveen, 2005). This pertains to having a perspective sense on the human self within the world and getting the better of self-absorption. However, it is important to note that Sadler-Smith (2013) pointed out that this list is preliminary with no claim to exhaustiveness or definitiveness.

OEVs only become impactful at organisational level should people themselves be already predisposed to the appropriate virtues as well as organisations enabling the manifestation of these predispositions in organisational outcomes, processes and systems (Sadler-Smith, 2013). Therefore, there is a possibility in which organisations can transform into avenues of OEV, that manifest environmentally favourable behaviours that promote environmental sustainability. Conversely, Sadler-Smith (2013) states they

could also become environmentally vice organisations which manifest agnostic environmental behaviours which are unsustainable and produce harm.

The idea relating to positive deviation propels these arguments one step further. As mentioned above, according to Bright, Fry and Cooperrider (2006), additionally, positive deviance from the viewpoint of POS is seen as preventing weaknesses that are opposing to normative negative momentum which tends to strengthen adherence to the generally accepted normal as well as allowing extraordinariness which is in accordance to common good. Within the environment's sphere, this type of deviance will be instantiated within organisational environmental practices which go beyond minimal norms, positively deviate from others within the similar domain or industry, provide wide social benefits and ease the effect of their actions on the environment in a manner that exceeds what is mandated by regulations (Walls & Hoffman, 2013). Positive deviance has a powerful leveraging impact in that it can lead to a basic elevation of industry and organisational norms and related boarder scale modifications.

The possible risks linked to climate change provide substantial problems regarding the environmental adequacy of various organisational processes, structures and strategies relating to many different organisations. These circumstances lead to the call for organisational change and development. Lines (2005) provided the HRD community with various basic guidelines pertaining to change management which could be applied to favourable environmental behavioural changes. As individuals decide on the change process from the outset, the first stages relating to change management are critical with respect to influencing attitudes (Line, 2005). Therefore, these stages are critical for providing compelling and simple messages such as utilising initiatives that decrease psychological distance. Additionally, according to Haidt (2001), Pidgeon (2012) and Seabright (2010), emotional responses to change are key constrainers or enablers for organisational change. As such, Lines (2005) proposed the following two possibilities. First, emotions that are negative might be counterproductive, therefore stimulating emotions that are positive like optimism instead of negative emotion like doom is more likely to be increasingly effective. Second, utilising the usage of fear appeals while at the same time supplying a convincing coping method to deal with the danger through adapting to and mitigating against climate change. Line (2005) importantly states that the second way is a more risky strategy. Lastly, Line (2005) states that organisational rationale regarding undergoing change can be restricted in terms of impact if the change is not expressed through a powerful value and belief set such as virtue basis language and if it does not avoid a forced top-down managerial language. Lastly, senior leadership and transformational change are critical in this process.

RECOMMENDATIONS

This paper suggested that a two-dimensional, system-wide approach between the individual and the organisation is far more effective than just concentrating on the organisation or individual in complete isolation. Furthermore, HRD consists of a distinguishable as well as a long history in enabling and also facilitating individual development and learning as well as organisational change and development. As such, this paper illustrated HRD's potential role in communicating the risk of climate change and promoting favourable environmental behavioural changes at both organisational as well as individual level. However, this paper only acknowledged HRD's role through individual development and learning and organisational change and development but did not touch on the overall initiatives and starting points

in which, an organisation can become green, and furthermore, implement a green HRD function within the organisation.

In addition, this paper further recommends organisations:

- Implement power saving policies such as starting up of the office early in the morning.
- Perform an audit of the internal environment as well as an energy audit within the organisation.
- Carry out going green or eco-friendly surveys.
- Implement a paperless policy through utilising application, software and electronic HRM.
- Engage in waste recycling.
- Reduce business travel such as using teleconferences rather than travelling.
- Conserve water such as monitoring toilets and sinks for leaks which waste water.
- Seek out and investigate opportunities for putting in place alternative sources of energy.
- The greening of all functions and operations of HRM including employee relations, training, development as well as performance management.

FUTURE RESEARCH

This study focused on the manner in which HRD in its singular capacity can serve as a key role player in communicating the risk of climate change and promoting pro-environmental behavioural changes at individual and organisational level. However, a study that could expand on the above can involve an inter-disciplinary approach toward climate change including a vast range of expertise and knowledge whereby the study will concur with the viewpoint of this study. Furthermore, it will also draw on theories, models and concepts, models from psychology, environmental science, POS and virtue ethics to further deliver an integrated framework that will support an inter-disciplinary approach in efforts to achieve the adaption to as well as mitigation of climate change.

CONCLUSION

In conclusion, HRD is ideally positioned to appear at the front line of the development as well as implementation of organisational and individual development and change and learning initiatives that deal with psychological distance as well as mobilize domestic responses. Furthermore, it is also positioned to facilitate environmentally virtuous organisational as well as individual behaviours in a positively deviant manner. This paper contributes toward literature pertaining to green HRD in the following two ways. Firstly, individual development as well as learning aimed at risk communication should concentrate on a smaller amount of salient and clear communication delivered in a manner that is appealing to concrete as well as local construals, thus lowering psychological distance as well as enhancing the likelihood of modifying individuals' behaviours. Secondly, with regards to organisational change as well as development, OEV associated with positive deviance should provide a feasible framework for change initiatives created and developed to confront and question cultural organisational norms as well as to encourage favourable environmental behaviours.

REFERENCES

- Arda, O. A., Bayraktar, E., & Tatoglu, E. (2019). How do integrated quality and environmental management practices affect firm performance? Mediating roles of quality performance and environmental proactivity. *Business Strategy and the Environment*, 28(1), 64–78. doi:10.1002/bse.2190
- Arnett, D. B., Laverie, D. A., & McLane, C. (2002). Using job satisfaction and pride as internal-marketing tools. *The Cornell Hotel and Restaurant Administration Quarterly*, 43(2), 87–96. doi:10.1177/001088040204300209
- Arslan-Ayaydin, O., & Thewissen, J. (2016). The financial reward for environmental performance in the energy sector. *Energy & Environment*, 27(3-4), 389–413. doi:10.1177/0958305X15627547
- Bae, B., & Sami, H. (2005). The effect of potential environmental liabilities on earnings response coefficients. *Journal of Accounting, Auditing & Finance*, 20(1), 43–70. doi:10.1177/0148558X0502000103
- Bayon, R., Hawn, A., & Hamilton, K. (2012). *Voluntary carbon markets: An international business guide to what they are and how they work*. Routledge and Taylor & Francis Group.
- Beharry-Ramraj, A., & Amolo, J. (2020). *Appraising the Future of Employee Health and Wellness Programmes in the Fourth Industrial Revolution*. Retrieved from: <https://www.igi-global.com/chapter/appraising-the-future-of-employee-health-and-wellness-programmes-in-the-fourth-industrial-revolution/265612>
- Bisbis, M. B., Gruda, N., & Blanke, M. (2018). Potential impacts of climate change on vegetable production and product quality – A review. *Journal of Cleaner Production*, 170, 1602–1620. doi:10.1016/j.jclepro.2017.09.224
- Bright, D. S., Fry, R. E., & Cooperrider, D. L. (2006). Transformative innovations for the mutual benefit of business society, and environment. *BAWB Interactive Working Paper Series*, 1(1), 17-31.
- Cameron, D. B., & Caza, A. (2004). Exploring the relationships between organizational virtuousness and performance. *The American Behavioral Scientist*, 47(6), 766–790. doi:10.1177/0002764203260209
- Cameron, K. S. (2003). *Organizational virtuousness and performance*. Academic Press.
- Chan, E. S., & Hawkins, R. (2010). Attitude towards EMSs in an international hotel: An exploratory case study. *International Journal of Hospitality Management*, 29(4), 641–651. doi:10.1016/j.ijhm.2009.12.002
- Chersich, M. F., & Wright, C. Y. (2019). Climate change adaptation in South Africa: A case study on the role of the health sector. *Globalization and Health*, 15(1), 22. doi:10.1186/12992-019-0466-x PMID:30890178
- Clemencon, R. (2016). The two sides of the Paris Climate Agreement: Dismal Failure or Historic Breakthrough? *Journal of Environment & Development*, 25(1), 3–24. doi:10.1177/1070496516631362
- Combs, J., Liu, Y., Hall, A., & Ketchen, D. (2006). How much do high-performance work practices matter? A meta-analysis of their effects on organizational performance. *Personnel Psychology*, 59(3), 501–528. doi:10.1111/j.1744-6570.2006.00045.x

- Crotty, J., & Rodgers, P. (2012). Sustainable development in the Russia Federation: The limits of greening within industrial firms. *Corporate Social Responsibility and Environmental Management*, 19(3), 178–190. doi:10.1002/csr.263
- Daily, B. F., Bishop, J. W., & Govindarajulu, N. (2009). A conceptual model for organizational citizenship behavior directed toward the environment. *Business & Society*, 48(2), 243–256. doi:10.1177/0007650308315439
- Daily, B. F., Bishop, J. W., & Massoud, J. A. (2012). The role of training and empowerment in environmental performance. *International Journal of Operations & Production Management*, 32(5), 631–647. doi:10.1108/01443571211226524
- Delmas, M., & Toffel, M. W. (2004). Stakeholders and environmental management practices: An institutional framework. *Business Strategy and the Environment*, 13(4), 209–222. doi:10.1002/bse.409
- Dewhurst, M., & Guthridge, M. (2009). *Motivating people: Getting beyond money*. Retrieved from: <https://www.mckinsey.com/business-functions/organization/our-insights/motivating-people-getting-beyond-money>
- Dutta, D. (2012). Greening people: A strategic dimension. *ZENITH International Journal of Business Economics & Management Research*, 2(2), 143–148.
- Elfeky, M. I. (2017). The extent of voluntary disclosure and its determinants in emerging markets: Evidence from Egypt. *The Journal of Finance and Data Science*, 3(1), 45–59. doi:10.1016/j.jfds.2017.09.005
- Fayyazi, M., Shahbazmoradi, S., Afshar, Z., & Shahbazmoradi, M. (2015). Investigating the barriers of the green human resource management implementation in oil industry. *Management Science Letters*, 5(1), 101–108.
- Fernández, E., Junquera, B., & Ordiz, M. (2003). Organizational culture and human resources in the environmental issue: A review of the literature. *International Journal of Human Resource Management*, 14(4), 634–656. doi:10.1080/0958519032000057628
- Frasz, G. (2005). Benevolence as an environmental virtue. In R. Sandler & P. Cafaro (Eds.), *Environmental virtue ethics* (pp. 121–139). Rowman & Littlefield.
- Garavan, T. N., & McGuire, D. (2010). Human resource development and society: Human resource development's role in embedding corporate social responsibility, sustainability, and ethics in organizations. *Advances in Developing Human Resources*, 12(5), 487–507. doi:10.1177/1523422310394757
- Gholami, H., Rezaei, G., Saman, M. Z. M., Sharif, S., & Zakuan, N. (2016). State-of-the-art Green HRM System: Sustainability in the sports center in Malaysia using a multi-methods approach and opportunities for future research. *Journal of Cleaner Production*, 124, 142–163. doi:10.1016/j.jclepro.2016.02.105
- Giannarakis, G., Zafeiriou, E., Arabatzis, G., & Partalidou, X. (2018). Determinants of corporate climate change disclosure for European firms. *Corporate Social Responsibility and Environmental Management*, 25(3), 281–294. doi:10.1002/csr.1461
- Giddens, A. (2011). *The politics of climate change: National responses to the challenge of Global warming*. Policy Network.

Human Resource Development's Role in Communicating the Risk of Climate Change

Girvetz, E., Rosenstock, T., & Nowak, A. (2019). Future Climate Projections in Africa: Where Are We Headed? In *The Climate-Smart Agriculture Papers*. Springer. doi:10.1007/978-3-319-92798-5_2

Gray, R. (2006). Social, environmental and sustainability reporting and organisational value creation? Whose value? Whose creation? *Accounting, Auditing & Accountability Journal*, 19(6), 793–819. doi:10.1108/09513570610709872

Hackman, R. J., & Oldham, G. (1976). Motivation through the design of work: Test of a theory. *Organizational Behavior and Human Performance*, 16(2), 250–279. doi:10.1016/0030-5073(76)90016-7

Haddock, J., Jeffrey, J., Miles, D., Muller-Camen, M., & Hartog, M. (2010). Green HRD: The potential contribution of HRD concepts and theories to environmental management. In *11th International Conference on Human Resource Development Research and Practice across Europe* (pp.1-18). Pécs, Hungary: University of Pécs.

Haidt, J. (2001). The emotional dog and its rational tail: A social intuitionist approach to moral judgment. *Psychological Review*, 108(4), 814–834. doi:10.1037/0033-295X.108.4.814 PMID:11699120

Harvey, F. (2015). *British belief in climate change on the rise, research finds*. Retrieved from: <https://www.theguardian.com/environment/2015/jan/29/british-belief-in-climate-change-at-highest-level-in-past-decade-survey>

Hecht, S. B. (2007). Climate change and the transformation of risk: Insurance matters. *UCLA Law Review*. University of California, Los Angeles. School of Law, 55, 1559.

Hoffman, A. J. (2010). Climate change as a cultural and behavioral issue: Addressing barriers and implementing solutions. *Organizational Dynamics*, 39(4), 295–305. doi:10.1016/j.orgdyn.2010.07.005

Holland, D., & Young, G. (2020). *The economic implications of climate change mitigation policies*. National Institute of Economic and Social Research., doi:10.1017/nie.2020.1

Hsu, A. W., & Wang, T. (2013). Does the market value corporate response to climate change? *Omega*, 41(2), 195–206. doi:10.1016/j.omega.2011.07.009

Hutchinson, D. S. (1995). Ethics. In J. Barnes (Ed.), *The Cambridge companion to Aristotle* (pp. 195–232). Cambridge University Press.

Intergovernmental Panel on Climate Change Fifth Assessment Report (IPCC AR5). (2014). *Approved summary for policy makers*. Retrieved from: <https://www.ipcc.ch/report/ar5/>

Jensen, M. C. (1994). Self-interest, altruism, incentives, and agency theory. *Journal of Applied Corporate Finance*, 7(2), 40–45. doi:10.1111/j.1745-6622.1994.tb00404.x

Khanna, M., Heng, L. L., & Chia, A. (2010). Measuring corporate environmental performance: a Delphi study on ranking environmental performance of companies in Singapore. In *Sustainability matters – Environmental Management in Asia* (pp. 63-82). Singapore: World Scientific Publishing Co. doi:10.1142/9789814322911_0003

- Kim, Y. J., Kim, W. G., Choi, H. M., & Phetvaroon, K. (2019). The effect of green human resource management on hotel employees' eco-friendly behavior and environmental performance. *International Journal of Hospitality Management*, 76, 83–93. doi:10.1016/j.ijhm.2018.04.007
- Kunreuther, H. C., & Michel-Kerjan, E. O. (2007). *Climate change, insurability of large-scale disasters and the emerging liability challenge*. National Bureau of Economic Research. doi:10.3386/w12821
- Kwong, J. (2005). Globalization's effects on the environment. *Society*, 42(2), 21–28. doi:10.1007/BF02687396
- Lines, R. (2005). The structure and function of attitudes toward organizational change. *Human Resource Development Review*, 4(1), 8–32. doi:10.1177/1534484304273818
- Marlon, J. R., Leiserowitz, A., & Feinberg, G. (2013). *Scientific and public perspectives on climate change*. Yale Project on Climate Change Communication, Yale University.
- McCarthy, T. (2014). *Meet the Republicans in Congress who don't believe climate change is real*. Retrieved from: <https://www.theguardian.com/environment/2014/nov/17/climate-changedenial-scepticism-republicans-congress>
- McGuire, D. (2010). Engaging organizations in environmental change: A green print for action. *Advances in Developing Human Resources*, 12(5), 508–523. doi:10.1177/1523422310394759
- McGuire, J., Sundgren, A., & Schneeweis, T. (1988). Corporate social responsibility and firm financial performance. *Academy of Management Journal*, 31(4), 854–872.
- Milstein, M. B., Hart, S. L., & York, A. S. (2002). Coercion breeds variation: The differential impact of isomorphic pressures on environmental strategies. In A. J. Hoffman & M. J. Ventresca (Eds.), *Organizations, policy, and the natural environment* (pp. 151-172). Stanford University Press.
- Moore, G., & Beadle, R. (2006). In search of organizational virtue in business: Agents, goods, practices, institutions and environments. *Organization Studies*, 27(3), 369–389. doi:10.1177/0170840606062427
- Morton, S., Pencheon, D., & Squires, N. (2017). Sustainable Development Goals (SDGs), and their implementation: A national global framework for health, development and equity needs a systems approach at every level. *British Medical Bulletin*, 1–10. doi:10.1093/bmb/ldx031 PMID:29069332
- Moyo, M., & Wingard, H. C. (2015). An assessment of the impact of climate change on the financial performance of South African companies. *Journal of Governance and Regulation*, 4(2), 49–62. doi:10.22495/jgr_v4_i2_p5
- Munasinghe, M. (2002). The sustainomics trans-disciplinary meta-framework for making Development more sustainable: Applications to energy issues. *International Journal of Sustainable Development*, 4(2), 6–54. doi:10.1504/IJSD.2002.002563
- Muthulingam, S., Corbett, C., Benartzi, S., & Oppenheim, B. (2013). Energy efficiency in small and medium-sized manufacturing firms: Order effects and the adoption of process improvement recommendations. *Manufacturing & Service Operations Management*, 15(4), 596–615. doi:10.1287/msom.2013.0439

Human Resource Development's Role in Communicating the Risk of Climate Change

Nejati, M., Rabiei, S., & Jabbour, C. J. C. (2017). Envisioning the invisible: Understanding the synergy between green human resource management and green supply chain management in manufacturing firms in Iran in light of the moderating effect of employees' resistance to change. *Journal of Cleaner Production*, *168*, 163–172. doi:10.1016/j.jclepro.2017.08.213

O'Donohue, W., & Torugsa, N. (2016). The moderating effect of 'Green' HRM on the association between proactive environmental management and financial performance in small firms. *International Journal of Human Resource Management*, *27*(2), 239–261. doi:10.1080/09585192.2015.1063078

Owusu, P. A., & Asumadu-Sarkodie, S. (2016). A review of renewable energy sources, sustainability issues and climate change mitigation. *Cogent Engineering*, *3*(1), 1167990. doi:10.1080/23311916.2016.1167990

Paillé, P., Chen, Y., Boiral, O., & Jin, J. (2014). The impact of human resource management on environmental performance: An employee-level study. *Journal of Business Ethics*, *121*(3), 451–466. doi:10.1007/10551-013-1732-0

Paris Agreement climate pledges. (n.d.). Retrieved from: https://www.eurekalert.org/pub_releases/2019-11/tca-ttb110119.php

Pidgeon, N. (2012). Climate change risk perception and communication: Addressing a critical moment. *Risk Analysis: An International Journal*, *32*(6), 951–956. doi:10.1111/j.1539-6924.2012.01856.x PMID:22708693

Pollock, T. G., Whitbred, R. C., & Contractor, N. (2000). Social information processing and job characteristics. A simultaneous test of two theories with implications for job satisfaction. *Human Communication Research*, *26*(2), 292–330. doi:10.1093/hcr/26.2.292

PricewaterhouseCoopers (PWC). (2016). *PWC's navigating the SDG's: A business guide to engaging with the UN global goals 2016 on SDG 13 Climate action*. Retrieved from <https://www.pwc.com/mul/en/events/CRA2019/cragoals/Goal13.pdf>

Renwick, D. W., Redman, T., & Maguire, S. (2013). Green human resource management: A review and research agenda. *International Journal of Management Reviews*, *15*(1), 1–14. doi:10.1111/j.1468-2370.2011.00328.x

Reynolds, T. W., Bostrom, A., Read, D., & Morgan, M. G. (2010). Now what do people know about global climate change? Survey studies of educated laypeople. *Risk Analysis: An International Journal*, *30*(10), 1520–1538. doi:10.1111/j.1539-6924.2010.01448.x PMID:20649942

Rojas Blanco, A. V. (2006). Local initiatives and adaptation to climate change. *Disasters*, *30*(1), 140–147. doi:10.1111/j.1467-9523.2006.00311.x PMID:16512866

Roscoe, S., Subramanian, N., Jabbour, C. J., & Chong, T. (2019). Green human resource management and the enablers of green organisational culture: Enhancing a firm's environmental performance for sustainable development. *Business Strategy and the Environment*, *28*(5), 737–749. doi:10.1002/bse.2277

Sadler-Smith, E. (2013). Toward organizational environmental virtuousness. *The Journal of Applied Behavioral Science*, *49*(1), 123–148. doi:10.1177/0021886312471856

- Sadler-Smith, E. (2014). Making sense of global warming: Designing a human resource development response. *European Journal of Training and Development*, 38(5), 387–397. doi:10.1108/EJTD-07-2013-0076
- Sadler-Smith, E. (2015). Communicating climate change risk and enabling pro-environmental behavioral change through human resource development. *Advances in Developing Human Resources*, 17(4), 442–459. doi:10.1177/1523422315601087
- Sandler, R. (2005). Introduction: Environmental virtue ethics. In R. Sandler & P. Cafaro (Eds.), *Environmental virtue ethics* (pp. 1–12). Rowman & Littlefield.
- Scannell, L., & Gifford, R. (2013). Personally relevant climate change: The role of place attachment and local versus global message framing in engagement. *Environment and Behavior*, 45(1), 60–85. doi:10.1177/0013916511421196
- Schaltegger, S., & Synnøstvedt, T. (2002). The link between ‘green’ and economic success: Environmental management as the crucial trigger between environmental and economic performance. *Journal of Environmental Management*, 65(4), 339–346. PMID:12369398
- Scully-Russ, E. (2012). Human resource development and sustainability: Beyond sustainable organizations. *Human Resource Development International*, 15(4), 399–415. doi:10.1080/13678868.2012.707529
- Scully-Russ, E. (2015). The contours of green human resource development. *Advances in Developing Human Resources*, 17(4), 411–425. doi:10.1177/1523422315600839
- Seabright, M. A. (2010). The role of the affect heuristic in moral reactions to climate change. *Journal of Global Ethics*, 6(1), 5–15. doi:10.1080/17449621003701410
- Secinaro, S., Brescia, V., Calandra, D., & Saiti, B. (2020). Impact of climate change mitigation policies on corporate financial performance: Evidence-based on European publicly listed firms. *Corporate Social Responsibility and Environmental Management*, 27(6), 2491–2501. doi:10.1002/csr.1971
- Senge, P. M. (1997). The fifth discipline. *Measuring Business Excellence*, 1(3), 46–51. doi:10.1108/eb025496
- Senge, P. M., Carstedt, G., & Porter, P. L. (2001). Next industrial revolution. *MIT Sloan Management Review*, 42(2), 24–38.
- Shafaei, A., Nejati, M., & Yusoff, Y. M. (2020). Green human resource management: A two-study investigation of antecedents and outcomes. *International Journal of Manpower*, 41(7), 1041–1060. doi:10.1108/IJM-08-2019-0406
- Sheopuri, A., & Sheopuri, A. (2015). Green HR practices in the changing workplace. *Business Dimensions*, 2(1), 13–26.
- Shi, Y., Magnan, M., & Kim, J. B. (2012). Do countries matter for voluntary disclosure? Evidence from cross-listed firms in the US. *Journal of International Business Studies*, 43(2), 143–165. doi:10.1057/jibs.2011.38

Human Resource Development's Role in Communicating the Risk of Climate Change

Soyka, P. A. (2012). *Creating a sustainable organization: Approaches for enhancing corporate value through sustainability*. FT Press.

Spence, A., Poortinga, W., & Pidgeon, N. (2012). The psychological distance of climate change. *Risk Analysis: An International Journal*, 32(6), 957–972. doi:10.1111/j.1539-6924.2011.01695.x PMID:21992607

Spreitzer, G. M., & Sonenshein, S. (2004). Toward the construct definition of positive deviance. *The American Behavioral Scientist*, 47(6), 828–847. doi:10.1177/0002764203260212

Stern, N. (2014). *The economics of climate change*. Cambridge University Press.

Stern, P. C., Dietz, T., & Kalof, L. (1993). Value orientations, gender, and environmental concern. *Environment and Behavior*, 25(5), 322–348. doi:10.1177/0013916593255002

Suchman, M. C. (1995). Managing legitimacy: Strategic and institutional approaches. *Academy of Management Review*, 20(3), 571–610. doi:10.5465/amr.1995.9508080331

Sudin, S. (2011, June). Strategic green HRM: A proposed model that supports corporate environmental citizenship. In *International Conference on Sociality and Economics Development, IPEDR* (pp. 79-83). Prentice Hall.

Swanson, R. A. (1998). Demonstrating the financial benefit of human resource development: Status and update on the theory and practice. *Human Resource Development Quarterly*, 9(3), 285–295. doi:10.1002/hrdq.3920090307

Tariq, S., Jan, F. A., & Ahmad, M. S. (2016). Green employee empowerment: A systematic literature review on state-of-art in green human resource management. *Quality & Quantity*, 50(1), 237–269. doi:10.1007/11135-014-0146-0

Teixeira, A. A., Jabbour, C. J. C., de Sousa Jabbour, A. B. L., Latan, H., & De Oliveira, J. H. C. (2016). Green training and green supply chain management: Evidence from Brazilian firms. *Journal of Cleaner Production*, 116, 170–176. doi:10.1016/j.jclepro.2015.12.061

Teoh, H. Y., Pin, F. W., Joo, T. T., & Ling, Y. Y. (1998). Environmental disclosures-financial performance link: Further evidence from industrialising economy perspective. In *APIRA 98 Conference, Paper* (No. 40). Academic Press.

The Global Warming Policy Foundation. (2020). *The Global Warming Policy Foundation*. Retrieved from: <https://www.thegwpf.org/>

Ulrich, D. (1997). Measuring human resources: an overview of practice and a prescription for results. Human Resource Management: Published in Cooperation with the School of Business Administration. *The University of Michigan and in alliance with the Society of Human Resources Management*, 36(3), 303-320.

Unilever. (2014). *Sustainable living*. Retrieved from: <https://www.unilever.com/sustainable-living/>

United Nations. (2015). *Transforming our world: the 2030 Agenda for Sustainable Development* (Report No. A/RES/70/1). United Nations. https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E

Human Resource Development's Role in Communicating the Risk of Climate Change

United Nations. (2019). Review of SDG implementation and interrelations among goals: Discussion on SDG 13 – Climate action including the link to the Climate Action Summit and six action portfolios. In *Global conference on strengthening synergies between the Paris Agreement on climate change and the 2030 Agenda for Sustainable Development* (pp. 1–99). Copenhagen, Denmark: United Nations.

van der Bank, M., & Karsten, J. (2020, January). Climate Change and South Africa: A Critical Analysis of the Earthlife Africa Johannesburg and Another v Minister of Energy and Others 65662/16 (2017) Case and the Drive for Concrete Climate Practices. *Air, Soil and Water Research*, 13. Advance online publication. doi:10.1177/1178622119885372

Van Wensveen, L. (2005). Cardinal environmental virtues: A neurobiological perspective. In R. Sandler & P. Cafaro (Eds.), *Environmental virtue ethics* (pp. 173–194). Rowman & Littlefield.

Walls, J. L., & Hoffman, A. J. (2013). Exceptional boards: Environmental experience and positive deviance from institutional norms. *Journal of Organizational Behavior*, 34(2), 253–271. doi:10.1002/job.1813

Watson, R., McCarthy, J., Canziani, P., Nicikenovic, N., & Hisas, L. (2019). *The truth behind Paris Agreement climate pledges*. Retrieved from: https://www.eurekaalert.org/pub_releases/2019-11/tca-ttb110119.php

Wenz, P. (2005). Synergistic environmental virtues: Consumerism and human flourishing. In R. Sandler & P. Cafaro (Eds.), *Environmental virtue ethics* (pp. 194–197). Rowman & Littlefield.

Wilson, E. O. (1994). *The diversity of life*. Penguin.

Wood, D. J. (1991). Corporate social performance revisited. *Academy of Management Review*, 16(4), 691–718. doi:10.5465/amr.1991.4279616

World Meteorological Organization. (2019). *WMO confirms past 4 years were warmest on record*. Retrieved from <https://public.wmo.int/en/media/press-release/wmo-confirms-past-4-years-were-warmest-record>

Yusoff, Y. M., Nejati, M., Kee, D. M. H., & Amran, A. (2020). Linking green human resource management practices to environmental performance in hotel industry. *Global Business Review*, 21(3), 663–680. doi:10.1177/0972150918779294

Chapter 11

Climate Change and the Sustainable Small and Medium-Sized Enterprises

Vanessa Gaffar

Universitas Pendidikan Indonesia, Indonesia

Tika Koeswandi

Universitas Pendidikan Indonesia, Indonesia

ABSTRACT

Small and medium-sized enterprises (SMEs) play an essential role as the key driver in national economic resilience. In developing countries, they contribute to most of the GDP every year. Like a coin with two sides, the rise of SME productivity accidentally caused the increase in global pollution. Now, the SMEs are urged to adjust and set the best strategies to encounter the circumstances. This chapter shares a broader perspective, literature studies, and documentary analysis on the definition and category of SMEs, the involvement of United Nations' Sustainable Development Goals (SDGs), green practices and strategies, and the issue of building sustainable SMEs in relation with climate change. It is also completed with some case studies in SMEs in Indonesia, Africa, United Kingdom, and many more. The chapters set the tone for the rest of the chapters examining the implications of the issues discussed for climate change and the sustainable financial factor.

INTRODUCTION

Climate change has been one of the notable topics of discussion since 1990. Humans and their economic activities are the most contributing agent in the last 30 years (Ahmed, 2020; Albritton, 1992; Georgieva, 2009; Hamann et al., 2017; Helmer & Hilhorst, 2006; Kannan & Boie, 2003). The advances in technology and the industrial revolution have become triggers for decisions in the economic sphere to use natural resources and ignore their effects on natural conditions. On the other hand, like a domino effect, the impact of climate change cannot be postponed. It can slowly be felt through the depletion of

DOI: 10.4018/978-1-7998-7967-1.ch011

the ozone layer, changes in agricultural patterns, drought, natural disasters, which have an impact on humanitarian issues such as poverty and hunger that also have an impact on the health sector and the economy (Intergovernmental Panel on Climate Change, 2001).

Since 1988, the attention to climate change has been echoed through meetings and policies, such as in the 1988 Montreal Protocol. Then globally, the United Nations continues to provide education and awareness through the 1988 Toronto Conference on “The Changing Atmosphere: Implications for Global Security” and the Hamburg Congress (United Nations, 1990). In 2015, United Nations proposed a universal agenda concern with ending poverty, protecting the planet and improving the lives, and prospecting everyone through a concept called The Sustainable Development Goals (SDGs) (United Nations, 2021). The SDGs program that starts with ‘*no poverty*’ and ends with ‘*partnership for the goals*’ means building sustainable development in all countries needs to start with equal distribution of consumption that will have a cooperative partnership in growth, social inclusion, and environmental protection.

In 2021, the Sustainability Development Goals (SDGs) agenda will arrive at its fifth goal. In fulfilling the goal, there is a concept of collaboration that is called four pillars. They consist of 1) state-owned sector 2) private sector 3) Social sectors (NGOs) 4) Fourth Sector (Rubio-Mozos et al., 2019). The first until third pillars have been the most significant pillar for some developed countries. However, for the developing country, the fourth sector has an essential role in being the backbone of economic resilience. It is Small Medium-sized Enterprises (SMEs).

Small Medium-sized Enterprises (SMEs) define as terminology that refers to small businesses, and they are categorized based on business scope, assets, and a number of employees. For the developing country, SMEs have contributed actively to the national Gross Domestic Product (GDP). Some developing countries rely significantly upon them, such as Indonesia, which contributes to 60%, Sub-Saharan Africa, which contribute to 58%, Morocco to 40% and Lebanon to 146% to the national GDP (Africa Economic Outlook, 2014; BPS-Statistic Indonesia, 2021; Hadj, 2020; The Consultation and Research Institute, 2005; and World Bank, 2008).

The good news on how SMEs have made a very significant contribution to countries’ economies, like a coin with two sides, SMEs’ high productivity accidentally becomes a contributing factor in climate change, such as the increase in carbon dioxide emissions, global pollution, and the rise of demand and supply from the raw material. This dilemmatic position of the SMEs is needed to analyze so that sustainable SMEs can be built and the climate change issue can be halted.

Thus, this chapter’s objectives share a broader perspective, literature studies, and documentary analysis on the definition of SMEs, the role of SMEs in the Sustainable Development Goals (SDGs), green practices and strategies, and the issue of how to build a sustainable SMEs in relation with climate change issue (controversy, problem, solutions and recommendations). It is also completed with some case studies in SMEs in Indonesia, South Africa, Germany and many more. The chapter sets the tone for the rest of the chapters examining the implications of the issues discussed for climate change and the sustainable financial factor.

BACKGROUND

Small Medium-Sized Enterprises (SMEs)

The terminology of Small Medium-size Enterprises (SMEs) has a variety of definitions. Many experts & academics refer to Small Medium-size enterprises as small businesses, while others refer to them as small and medium-sized enterprises, and the rest refer to them as micro, small and medium enterprises (Karadag, 2015). The OECD (2000) defines SMEs as non-subsidary, independent firms that employ fewer than a given number of employees. Karadag (2015) highlights that “The differences in SME definition extend in three flanks: definitions by international institutions, definitions by national laws, and industry definitions” (p. 15). Nevertheless, Small Medium-sized Enterprises (SMEs) ‘ critical point is constructed into the number of employees and its value.

The World Bank Institute (2004) categorized the Micro Small and Medium Enterprises as follows:

1. **Medium enterprise**, the businesses that employ less than 300 employees and have an annual turnover and / or balance sheet that does not exceed USD 15 million.
2. **Small enterprise**, the businesses that employ less than 50 employees and have an annual turnover and / or balance sheet does not exceed USD 3 million.
3. **Microenterprise**, the businesses that employ less than ten employees with an annual turnover and / or balance sheet that does not exceed USD 100 thousand.

The European Commission Recommendation (2009), Small Medium-sized Enterprises are grouped into three categories. This categorization is based on the number of employees, annual turnover, and annual balance sheet. Those three categories are described as follow:

1. **Medium enterprise**, the businesses that employ less than 250 employees and have an annual turnover that does not exceed EUR 50 million and / or an annual balance sheet that does not exceed EUR 43 million.
2. **Small enterprises**, the businesses that employ less than 50 employees, have annual turnover and/ or balance sheet that does not exceed EUR 10 million.
3. **Microenterprise**, the businesses that employ less than ten employees with an annual turnover and / or balance sheet that does not exceed EUR 2 million.

According to The SME Promotional Law of China (2003), Small Medium-sized Enterprises are categorized as follow:

1. Small enterprises include industry, construction, wholesale, retail, transport, post and hotel & restaurant with less than 100 and maximum employee of 600, total asset less than ¥ 40million and business revenue is less than ¥ 30million.
2. Medium enterprises include industry, construction, wholesale, retail, transport, post, and hotel & restaurant with a maximum employee of 100 – 1000 employees, total asset ¥ 40 – 400 million, and business revenue is less than ¥ 10 – 300 million.

Besides, the EU SME center (2019) suggests that “SMEs in China are defined, according to the Law of the People’s Republic of China on the Promotion of Small and Medium-sized Enterprises (2017) (SME Promotion Law), as companies that “have a relatively small size in personnel and scope of business.” (p.1).

According to Law No. 20 of 2008 of the Republic of Indonesia, Micro Small and Medium Enterprises are categorized as follow:

1. **A microenterprise** is a productive business owned by an individual and/or an individual business entity that meets a micro business’s criteria as regulated in this law. A business included in the micro-enterprise category must have a maximum asset of IDR 50 million and a maximum turnover of IDR 300 million.
2. **Small enterprise** is an independent, productive economic business carried out by an individual or a business entity that is not a subsidiary or branch of a company that is owned, controlled, or is a part, either directly or indirectly, of a medium or large business that meets the criteria of Small Business as referred to this law. In a small enterprise category, the assets are > IDR 50 million to IDR 500 million, and the turnover is > IDR 300 million to IDR 2.5 billion.

A medium-sized enterprise is a productive economic enterprise that is independent, carried out by individuals or business entities that are not subsidiaries or branches of companies that are owned, controlled, or are part of, either directly or indirectly, with Small or large businesses with total net assets or annual sales proceeds as regulated in this law. In a medium enterprise category, assets are > IDR 500 million to IDR 10 billion, and turnover is > IDR 2.5 billion to IDR 50 billion.

Based on the explanation above, the terms Micro Small and Medium Enterprises (MSMEs) and Small Medium-sized Enterprises (SMEs) refer to the exact meaning of small businesses, and they are categorized based on business scope, assets, and a number of employees.

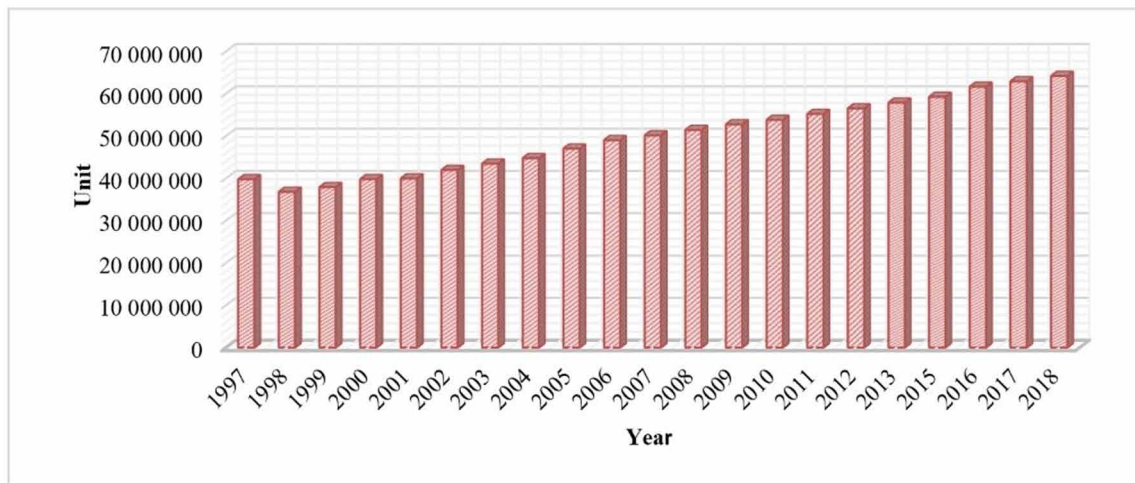
The history of the growth of SMEs in all countries has its significant records. In a developing country such as Indonesia, SMEs’ growth was started in 1999, a year after the monetary crisis struck Indonesia. At that time, Indonesia’s Rupiah was decreased by more than 200% against the US dollar, leading to the national banking crisis. According to Maksum et al. (2020), “Many large enterprises that used banking services and bought many imported materials went bankrupt while SMEs were the firm the entities could survive” (p.1). Thus, many people were interested in being an entrepreneur. This causes an increase in the number of SMEs in 1999. Figure 1 shows that in the last 20 years, the growth of SMEs has increased rapidly. Indonesia SMEs have become the national economy backbone ever since.

Twenty-two years after the monetary crisis, the number of Indonesia SMEs have reached 64.194.057 unit that consisted of 62.106.900 unit (micro-enterprises), 757.090 unit (small enterprises), and 58.627 unit (Medium enterprises). They concern at 18 fields of industries consist of 1) Agricultures, Hunting, and Forestry; 2) Fishery; 3) Mining and Quarrying; 4) Processing Industry; 5)Electricity, Gas, and Water; 6)Construction; 7)Wholesale and Retail Trade; 8) Provision of Accommodation and the Provision of Eating and Drinking; 9)Transportation, Warehousing, and Communications; 10) Financial Intermediaries; 11) Real Estate, Business, Ownership, and Business Services; 12)Government Administration, Defense, and Compulsory Social Security; 13)Education Services; 14)Health Services and Social Activities; 15)Community, Sociocultural, Entertainment, and Other; 16) Individual Services, Individual Services which Serve Households 17)International Agency and Other Extra Agency International; 18)Business Activities which are not clearly defined (Ministry of Cooperatives and Small and Medium Enterprises

Climate Change and the Sustainable Small and Medium-Sized Enterprises

of the Republic of Indonesia, 2018) and (BPS-Statistic Indonesia, 2021). This development gives new hope for Indonesia to have a sustainable economic resilient and global competitive advantage.

Figure 1. The Growth of SMEs in Indonesia in 1997-2018. (Adapted from [Indonesia Central Bureau of Statistics and Ministry of Cooperatives and Small and Medium Enterprises of the Republic of Indonesia])



The Role of SMEs in Sustainable Development Goals (SDGs)

Sustainable Development Goals (SDGs) is the United Nations program proposed in 2015 as a program concerned to harmonize the three main core objectives: economic growth, social inclusion, and environmental protection. This program has 17 goals that consist of 1) No Poverty 2) Zero Hunger 3) Good Health and Well-being 4) Quality Education 5) Gender Equality 6) Clean Water and Sanitation 7) Affordable and Clean Energy 8) Decent Work and Economic Growth 9) Industry Innovation and Infrastructure 10) Sustainable Cities and Communities 11) Responsible Consumption and Production 12) Climate Action 13) Life Below Water 14) Life on Land 15) Peace, Justice, and Strong Institution and 17) Partnership for Goals (United Nation, 2021). Figure 2 describes that the SDGs program starts with ‘no poverty’ and ends with ‘partnership for the goals’. It means that to create a sustainable development needs to start with equal distribution of consumption that will end to having a cooperative partnership in growth, social inclusion, and environmental protection.

The SDGs are the fruit of awareness and concern for the issue of climate change. Since 1988, the attention to climate change has been echoed through meetings and policies, such as in the 1988 Montreal Protocol. Then globally, the United Nations continues to provide education and awareness through the 1988 Toronto Conference on “The Changing Atmosphere: Implications for Global Security” and the Hamburg Congress (United Nations, 1990). Based on the prediction of forecasting in 2005, which is summarized in the European Year Book of International Economic Law, states that, in the next 50 years, (1) energy, (2) water, (3) food, (4) the environment, (5) poverty, (6) terrorism and war, (7) disease, (8) education, (9) democracy, and (10) population will be the main problems faced by humans (Leal-Arcas, 2019) whereas each country will maintain three principal supplies: energy, water, and food. These three

supplies are the leading sector for business explorations, and SMEs, as the key driver of national economics, play a vital role in controlling them. In the hope that the business activities do not be the new contributing agent for the climate change issue.

Figure 2. The icons and logo of United Nations sustainable development goals. (©Copyright 2015, United Nations. Used with Permission)



Research conducted by Lopes de Sousa Jabbour et al. (2020) portrayed a breakthrough finding of supportive factors for the SMEs in controlling climate change and supporting SDGs. Their study was an integrative literature review that successfully involved 236 papers where one of the samples had 469 citations on Google Scholar. The findings show there are two most important factors for SMEs in controlling climate change and supporting SDGs: external factors (Government) and internal factors (innovation & entrepreneurial orientation). The illustration of the findings can be seen below:

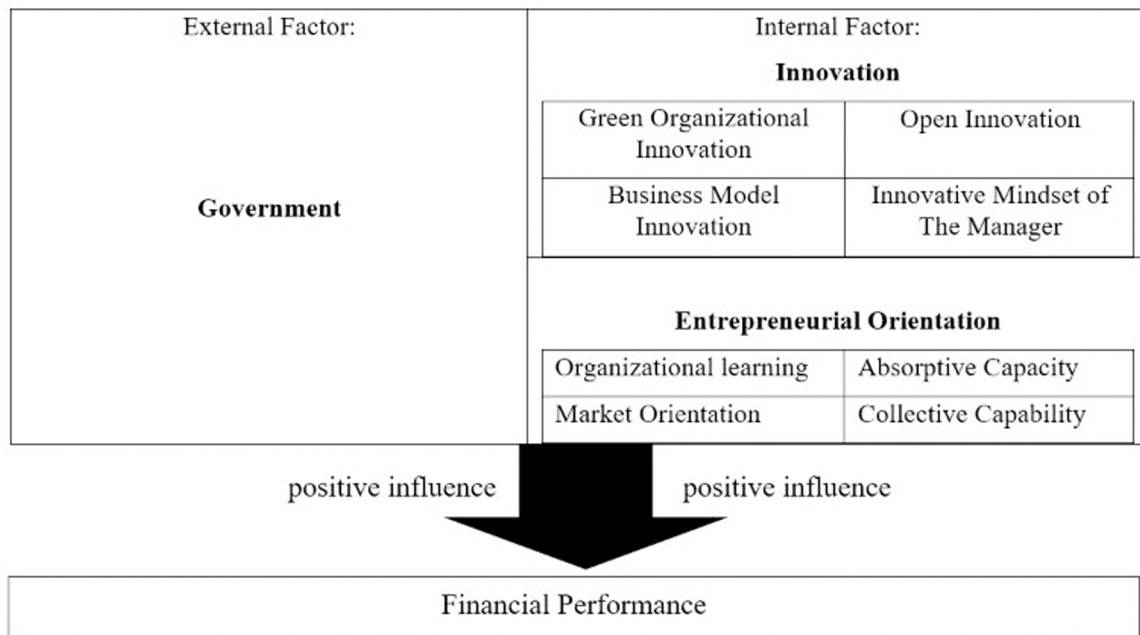
Figure 3 explains that all the business stakeholders need to understand that all stakeholders and internal sectors play an essential role in creating sustainable SMEs. The most significant factor is the innovation and entrepreneurial orientation. According to Merriam Webster (2021), innovation is a *new idea, method, or device*. Thus, the SMEs urge to start thinking about what kind of new movement, concept, product, or activities that be the bridge to be part of the SDGs. The four sub-factors can help create *innovation in green organizational* concepts and then *open up* to innovation *possibilities*. The human resources are also needed to comprehend that they need a new skilled *leader/manager* who has an *innovative mindset*, and then, finally, all the firms can start to reconsider their *business innovation model*. The second factor in internal is entrepreneurial orientation. It means that the firm needs to broader its orientation that

Climate Change and the Sustainable Small and Medium-Sized Enterprises

it is not about profit anymore. The first sub-factor is *organizational learning*. It evaluates what impact the firm has given to the people, planet, and prosperity as how the SDGs’ are trying to achieve and how it impacted the SMEs to climate change. It becomes the new trend of thinking. Second, *absorptive capacity* deals with how well the firm can get information from the external environment, such as the Government or any other entities, regarding the issue that may have been the challenge or threat for its life cycle. Third, *collective capability* deals with how well the stakeholder can match all the information absorb to then finally direct to one point of goal that will fully understand the new *market orientation* (Lopes de Sousa Jabbour et al., 2020).

In conclusion, to support the SDGs and reduce climate change, it needs a sustainable SME where support, strategy, and mindset come within and beyond the firm.

Figure 3. The influenced factors of SMEs in achieving SDGs and halting the climate change (Source: Lopes de Sousa Jabbour et al. (2020))



Green Practice and Strategy for SMEs

In 2021, many SMEs are trying to reduce their footprint in the environmental section by applying green practices and strategies. It is because human and their economic activities are also the contributing agents in the increase of climate change (Albritton, 1992). A green practice and strategy are tools to direct the SMEs in short and long-range focus. Green practice implements daily practical procedures in management and managerial aspects while green strategy is adopted to bring the firm reaches the green goal in the long-term. Nulkar (2014) supports that:

Green strategies direct organizational capacity towards green objectives and focus on outcomes and not technologies and processes. Green strategies start from top-down. While green practices look from the business's costs and drive innovation in solving them, green strategies address a firm's environmental impact and innovate to reduce it. Green strategies define the scope and decide the advantage that the firm wishes to create for itself. They have a long-range focus and require an organization-wide commitment instead of short-term results and departmental solutions for green practices. Green strategies address environmental objectives proactively rather than as a reaction. (p.132)

He then proposed a grid to map out the green effort and benefit in both practical and strategic. The grid can be seen in figure 4 below:

Figure 4. The grid of green efforts and benefits. (Adapted from [Nulkar (2014)])

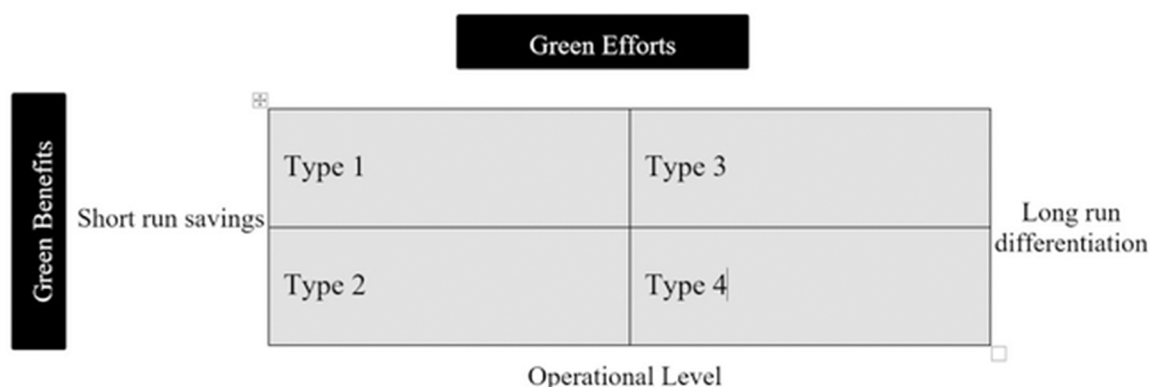


Figure 4 figures that type one is when the form has high short-run benefit but less operational effort. Type two is when the firm has a short benefit and less effort at the operational level. Type 3 is when the firm has a high and long benefit with long-term effort, and type 4 is when the firm has a short benefit, but it has long-run operational efforts. Let us look at an example of applying the Grid of Green Effort and Benefit (GGEB) below.

In India, a company called Gordej Industries Cummin India Gordej & Beyonce is categorized into the third type of GGEB (high and long benefits with long-term effort) because the company implements green practices through utilizing a green building concept and operating saving energy practice by reducing the number of printers and self-made server rooms. Not only that, but the company also disseminated notions and principles about 'going green' to the staff through a set of training. Thus, they calculate that this strategy can have a long-term impact in the next two years (Nulkar, 2014).

The key to implementing green practice and strategy lies in how much impact a company or a firm would like to reach. At this point, a profit will not necessarily in the form of money. It can be in also other types of advantages, such as:

1. Product development

Product development gives a business opportunity to design a win-win solution between enterprise and the environment (Qiu et al., 2020). Berchicci (2014) supports that Environmental Product Development (EPD) is re-designing the existing product while New Product Development (NPD) is creating new transform of product based on the market opportunity. Berchicci (2014) adds that when SMEs are concerned about their product development, it will lead them to have a long life-cycle of the business. Start-up is an example of *green entrepreneurship* whose product is classified as a New Product Development (NPD). With *the green initiative*, Start-up can transform a new product that is the cost of energy-saving both in production and promoting activities, less consumption of raw material and develop new market (Demirel et al., 2019) (Qiu et al., 2020). The growth of Start-ups in 2021 increases, and many young entrepreneurs are interested in developing this sector. The example of *green* Start-ups whose leader is young entrepreneurs are *Kitabisa.com* and *Tanihub* (Indonesia), *Facedrive* (Canada), *Powerledger* (Australia), *M-KopaSolar & Freedom Won* (Africa).

2. Competitive advantages

Nuklar (2014) defines competitive advantage as “The potential for environmental performance to improve long term profitability” (p.133). He proposed that by applying green practices and strategies, the SMEs can gain four competitive advantages, such as emerging market opportunities, an early mover advantage in the market, managing cost, and risk and being environmental stewardship (Nulkar, 2014).

Realizing how difficult it was to apply the green practices and strategies, the European Union and Canada made a Guide to Green Business for Small and Medium-sized Enterprises (SMEs) (Marushevskiy & Hickman, 2017). They proposed that there are specific actions to support the SMEs in implementing the *green wave*, include (i) promotion of eco-innovation by SMEs; (ii) facilitating business partnering, skills, and knowledge for green entrepreneurship; and (iii) exploiting the role of business clusters in support of eco-innovative SMEs (Marushevskiy & Hickman, 2017).

MAIN FOCUS OF THE CHAPTER

Issues: Building Sustainable SMEs in Relation With Climate Change

In 2021, the Sustainability Development Goals (SDGs) agenda will arrive at its fifth goal. In fulfilling the goal, there is a concept of collaboration that is called four pillars. They consist of 1) state-owned sector 2) private sector 3) Social sectors (NGOs) 4) Fourth Sector (Rubio-Mozos et al., 2019). The first until third pillars have been the most significant pillar for some developed countries. However, for the developing country, the fourth sector has an essential role in being the backbone of economic resilience. It is Small Medium-sized Enterprises (SMEs). In supporting SGDs goals, SMEs must create a sustainable business model oriented towards people, the planet, and prosperity. It can be achieved by analyzing 1) how significant SMEs' contribution to the nation's economy; 2) factors influence SMEs' development in achieving the SDGs.

Table 1. The growth of Indonesia GDP in 2010-2020

Year	Percentage (%)
2010	58,1
2011	57,8
2012	57,6
2013	57,5
2014	57,6
2015	57,8
2016	57,2
2017	57,1
2018	60,3
2019	60
2020	61

Source: (BPS-Statistic Indonesia, 2021)

The Contribution to The National Economy

Many indicators can measure contribution in the national economy, but the best parameter is the GDP (Gross Domestic Product) (Rubio-Mozos et al., 2019). In Indonesia, the fluctuation of GDP contribution happens in the last ten years. Table 1 shows that the lowest point was in 2017 when Indonesia SMEs contributed to only 57,1%. The contributing factor to slower growth in 2017 was the decline of household consumption where the middle- and upper-class people hold back consumption and weaken national export capacity due to slowing global economic growth (Praditya, 2017). Meanwhile, the highest point

was in 2020 in 61% or around IDR 8,400 trillion from the total of IDR 14,000 trillion. The number of business units in 2018 reached 64,194,057 business units or 99.99 percent of the total number of businesses, and the labor absorption was 97 percent of the 170 million total workforces in Indonesia (121 million workers) (BPS-Statistic Indonesia, 2021). Thus, OECD (2018) concludes that Indonesia has relatively healthy economic growth as a developing country with many sustainable SMEs.

According to Africa Economic Outlook (2014), SMEs in the Sub-Saharan Africa (SSA) sector contributed 47% of GDP in 1965 and scaled up to 58% in 2014. Abisuga-Oyekunle et al. (2020) support, “They (The SSA SMEs) play a significant role in both developed as well as developing economies and are the key generators of employment, income, and integration, and are drivers of innovation” (p.2). Research conducted by Hadj (2020) reports that “Morocco’s private sector is made up of about 98% of SMEs, which account for almost 40% of the gross domestic product (GDP). In Egypt, 99% of non-agriculture private sector projects are SMEs. The latter contributes 75% of total employment, and their production volume represents about 80% of GDP, of which 75% is destined for export” (p.2). In Lebanon, in the age of war, trade became the primary prospered industry. Many SMEs also concern about the trade industry (Canaan, 2011). In total, there were 72.6% of SMEs in the trade industry and made the trade industry shared 146% in Lebanon’s GDP in 2007 (The Consultation and Research Institute (2005) & World Bank (2008)). Thus, it can be concluded that SMEs in the most developing countries have been a sustainable firm entity that plays a significant role as the key drivers of the national economic resilient.

Factors Influencing the Development of SMEs in Achieving the SDGs

Internal Factor (Innovation & Entrepreneurial Orientation)

Implementing green practices and strategies in supporting one of the SDGs’ goals is considered the best strategy for SMEs in 2021. The SMEs can have a more futuristic, innovative, and pro-environment product development and competitive advantages in entering a new market. Furthermore, the entrepreneurial orientation will be limited to the profit, but it will concern more with how the SMEs can impact the broader scope (people, planet, and prosperity). However, neither easy nor difficult, the SMEs are still struggling with the implementation. Here is the situation on how the SMEs in some countries are ready with the green practices and strategies:

In India, the demand for electricity usage is the highest due to the fast-growing economy. Goel (2020) proposed that:

To meet the fast-growing economy, India needs to supply the energy 3-4 times more of what it is supplying now. India’s Government has become aware of the situation and has started facilitating policies in action towards sustainable energy. As of 2019, India’s on-grid renewable energy capacity is 85.9 GW. The Government is working to establish 500 GW of renewable energy sources by 2030. (p.1)

In Germany, energy-saving is unpopular due to the little benefit that the SMEs can earn. Kannan and Boie (2003) describe that to save 10% of Germany’s electricity, the SMEs need a technician/energy manager to supervise. If the technician’s salary is paid from the 10% saving cost, it needs 4-10 GWh to cover the technician’s wage. Meanwhile, in a year, the total cost of electricity in most SMEs is only 2GWh. That is why SMEs rarely consider saving energy because human resources cost is very high and energy is relatively cheap (Kannan & Boie, 2003).

Another example is the issue of reducing plastic consumption. A survey was done by a private agency named BRITA UK (2019). They asked the SMEs in Great Britain how they managed the plastic consumption and be part of the agent's halting climate change. The survey found that forty-three percent think their business does not have a responsibility to provide recycling facilities in the workplace, and a third think they are responsible for encouraging customers to recycle. Thirteen percent say they are not motivated at all by concern for the impact of business on the environment (BRITA UK, 2019, para. 2). It may surprise many parties that it indicates the British SMEs are also struggling in reducing plastic consumption. Like a domino effect, these examples above will also affect another stage of the problem.

In conclusion, it needs a strong integration among stakeholders to implement green practices and strategies. Many SMEs are still struggling, and their entrepreneurial orientation is the traditional for-profit purpose.

External Factor (Government and Other Organizations)

The support given by the Government to build sustainable SMEs in facing climate change may have been done for years. In South Korea, Government support for SME innovations is provided through many policies at the local, regional, and national levels. It can provide easily accessible information concerning innovation, cutting the administrative costs and burdens of SMEs to promote SME innovation, and promoting alliances and build networks among SMEs across sectors and cross borders (Doh & Kim, 2014). Indonesia, the other supports are also given in the financial banking sector with the KUR program (*Kredit Usaha Rakyat* / Citizen Business Credit), BEKRAF (*Badan Ekonomi Kreatif* / Economy Creative Agency), and also training in creating green product and marketing.

The support from the Government in Indonesia, at some point, also creates a debatable issue in environmental control. The Job Creation Act, Officially Law Number 11 of 2020, was passed on October 5, 2020, by Indonesia's People's Representative Council. The changes aim to create a job and increase foreign and domestic investment, but unconditionally, these reduce the requirements for a business permit and natural resources usage. The changes to the article are in Article 25 that states:

1. Any investors investing in Indonesia must comply with the provisions referred to in Article 5.
2. Ratification of establishing a domestic investment business entity in the form of a legal entity or not a legal entity is carried out by the provisions of laws and regulations.
3. Ratification of establishing a foreign investment business entity in the form of a limited liability company is carried out by the provisions of laws and regulations.
4. *4) Investment companies that will carry out business activities must fulfill Business Licenses from the Central Government or Regional Governments by their respective authorities based on the norms, standards, procedures, and criteria stipulated by the Central Government.* (translated by the Authors).

Controversies

The good news on how SMEs have made a very significant contribution to countries' economies, especially developing countries, impacts one other thing. Like a coin with two sides, SMEs' high productivity accidentally becomes a contributing factor in climate change, such as increased carbon dioxide emissions, global pollution, and the rise of demand and supply from the raw material. If the SMEs ignore renewable

Climate Change and the Sustainable Small and Medium-Sized Enterprises

energy or event air pollution, then like the other case, SMEs are no different. It is supported by various studies from (Revell and Blackburn, 2007) (Aragon et al., 2008) and Hadj (2020), who justified that the SMEs also contributed sixty percent of carbon dioxide emissions and seventy percent of global pollution

Another issue to consider is how the stakeholder has the same way of thinking in adopting the SME to be 'greener'. It cannot be denied that most SMEs still profit-oriented, and they do not consider climate change has been a prominent issue today. In terms of the external factor, the Government and any other organizations need to integrate the policy to provide a less ambiguous regulation.

Problems

After discussing the SMEs in almost all continents, many similar problems occurred to them. First, the motive of SMEs in joining the SDGs movement is still shallow. It is proven by the number of parties who are still apathetic about their business innovations to have an environmental business model. A motive such as social precursors also does not have a practical impact on growing awareness. The social pressure that business actors fear is because it is limited to fear of taxes or regulations. Second, related parties' lack of information and education for the small firms to understand climate change. The SDGs Movement goals cannot run optimally. In developing countries, the lack of information can be caused by a lack of resources such as facilities, time, and money. Third, cost efficiency is not profitable. The high wages of an expert in environmental protection make SMEs postpone their 'green' decision. The easy access and affordable use of energy create a new mindset that it is not a problem not to use renewable energy. Lastly, a business orientation that is still traditional for-profit oriented. In 2021, when the SDGs Movement has developed, it will be challenging to measure success only in currency weight. At this stage, what must be developed is a business orientation that assumes that nature is also a valuable scientific asset and needs to be preserved according to the principle of People, Planet, Profit.

Case Study

Let us look at the SMEs in preparing, adopting, and implementing practices and strategies in supporting the SDGs and halting climate change. The sources are news directly taken from sources such as The VOA Indonesia, The Jakarta Post, and The Afrik21.

Sumringah: A Patchwork Waste Recycling

VOA Indonesia (2019) - In Pringsewu, Lampung, many small industrial centers manufacture doormats or footwear, especially from rags. Small and medium enterprises employ employees, produce tens of thousands of doormats every month, and are sent to various countries. It was there that Ani Lailia, a 2013 student at the University of Lampung, was born and raised. Ani saw that many homemakers did not have other activities around her house besides doing their domestic duties. This condition gave her the idea to empower these women. Ani then created a cooperation scheme in which she provided raw materials, and homemakers filled their spare time with productive economic activities. Thus, it was born the social business of producing doormats, Sumringah. Initially, Sumringah implemented a wage-based work system, but it turned out to be ineffective. Then, Ani tried the partnership system. It turns out that the partnership system is more effective in terms of finance and more optimal. "Our partners are all housewives. They also have their respective activities. That is why this opportunity exists for mothers,

“said Ani. Ani saw that many homemakers did not have other activities apart from doing their domestic duties around her house. This condition gave her the idea to empower these women. Ani then made a cooperation scheme. She provides raw materials, and homemakers fill their spare time with productive economic activities; a doormat production social business is born, Sumringah.

Sumringah implemented a wage-based work system, but it turned out to be ineffective. Then, Ani tried the partnership system. It turns out that the partnership system is more effective in terms of finance and more optimal. “Our partners are all housewives. They also have their respective activities. That is why this opportunity exists for mothers,” said Ani. Since its establishment in March 2017, Sumringah doormat products have spread throughout Indonesia through online sales. There are 45 women joined in Sumringah, with the production of around 1,200 mats every month. Sumringah determines the product quality. Partners whose quality is not yet good enter the repair program. Sumringah also provides training services for homemakers who want to join them in producing mats.

Sumringah is one of the winners of the 2019 Indonesian Young Sociopreneur (Soprema) competition. The competition, which runs from May-14 to November 2019, is a sociopreneur incubation event held by the Youth Studies Center (YouSure) and the Student Research and Creative Corner (SRCC). Both are institutions from the Faculty of Social and Political Sciences UGM Yogyakarta. Sociopreneur or social business people calculate how much the environment receives the benefits of the business they run. For this reason, the business scheme places certain groups as important actors in the business. The business is not only driven by the owner but becomes common property.

Java Mountain Tree: Green Financing Collaboration

The Jakarta Post (2019) - Fintech lending platform Investree has announced the second round of a “green financing” partnership with social enterprise Java Mountain Coffee. According to a statement received by The Jakarta Post on Monday, the collaboration will allow Java Mountain Coffee to offer biodegradable coffee capsules filled with Indonesian coffee grown by all-women cooperatives in Bali and West Java of Four Seasons Resort Bali at Jimbaran Bay and Four Seasons Resort Bali at Sayan.

Currently, most hotels in Asia still provide their guests with plastic and aluminum in-room coffee capsules. “We thank Investree for their continued commitment to the empowerment of indigenous rural women through this second round of ‘green financing’ for Java Mountain Coffee,” said Nadine Alexandra, spokeswoman for Java Mountain Coffee, in the statement. This collaboration helps the travel, tourism, and hospitality industry advocate to remove the plastic and aluminum coffee capsules from their businesses and replace them with a circular solution, which ultimately is the best sustainable outcome for people from rural communities and the future of the earth. During the first “green financing” partnership, Java Mountain Coffee collaborated with Alila Seminyak and Alila Villas Uluwatu in Bali to provide similar eco-friendly in-room products. It takes three months to break down into compost after use. According to the World Bank, women in developing countries face difficulties in getting the capital they need for their businesses or initiatives, in addition to legal and policy obstacles. As a result of these challenges, fewer than 30 percent of small and medium enterprises (SMEs) are owned or run by women.

German’s Start-Up and Africa’s Provider to Solar Water Treatment

Takouleu (2021) - German start-up Grino Water Solutions will now provide its solar-powered water treatment solution at the ImpactSites of off-grid provider Africa GreenTec AG. The company installs

containerized solar systems in rural areas in several countries in West Africa. The partnership between the German start-up Grino Water Solutions and Africa GreenTec AG will facilitate the roll-out of the ImpactSites in West Africa. The solution, which integrates power generation and distribution and access to drinking water and the internet via WIFI, is provided by Africa GreenTec AG. Within the scope of its activities, including the installation of the ImpactSites, Africa GreenTec will commission the start-up Grino for its solar-powered water treatment solution.

Drinking water is a scarce commodity in the Sahel, Africa GreenTec AG's primary area of operation. In West African villages, the start-up is installing mini-grids that provide thousands of people with electricity access. The young company has installations in operation in several villages, such as in Sirakoro in the Kita district of Mali, in Dalakana in the Koulikoro district of Mali Amaloul, the Tahoua Region of Niger. Under the partnership, Grino will install 20 solar water treatment systems at Africa GreenTec's ImpactSites in 2021. "Our mission is not only to contribute directly to the sustainable development goals (SDG) No. 6 (access to drinking water and sanitation) and SDG 7 (access to clean energy), but also to achieve almost all SDGs by improving people's living standards and the development of local businesses," Grino says. In coastal localities, Grino is also installing solar-powered desalination systems. Recently, the start-up company commissioned a desalination system in Cape Coast in Ghana's Central Province. The installation provides 3,000 liters of water per day to the population and two schools in the city.

SOLUTIONS AND RECOMMENDATIONS

The solutions and recommendations offered to the issue, controversies, and problems related to climate change can be suggested: 1) The SMEs' stakeholders can be categorized into three, whether they are eco-entrepreneur eco-adopter eco-innovator. Eco-entrepreneur means they can start to focus on eco-friendly products that are interested in the existed market. Eco-adopter means they can adopt practices, strategies, and business models related to the SDGs movement. Eco-innovator means they will invent a breakthrough of business that is fully committed to preserving the environment and halt climate change. From this step, they can go next to the finding motive on business, whether it is involved and proactive to climate change or being socially forced to continue. 2) Using digital medium in helping the production process or any other renewable energy. The SMEs can start to consider moving to *Start-up* / creating a digital office where the stakeholder can work remotely at home, and a green building concept where the use of electricity can be changed by more renewable energy such as solar systems. In the marketing strategy, the use of paper as a poster in promoting can be changed by digital promoting. This sector is promising for the developing country as the future business world. 3) Implementing green practices and strategies. A green practice and strategy are tools to direct the SMEs in short and long-range focus. Green practice implements daily practical procedures in management and managerial to get while green strategy is adopted to bring the firm reaches the green goal in the long-term. Both practice and strategy have to concern with impact-oriented and goal-oriented. Green practices can be implemented, such as regulating the stakeholder to use a reusable cup in the office. Meanwhile, green strategies deal with the firm's goals to help people, the planet, and prosperity and the SDGs movement until 2030. With these solutions, there is a hope that sustainable SMEs will be created and that climate change will be halted.

FUTURE RESEARCH DIRECTIONS

As the future research direction, this chapter suggests exploring how sustainable SMEs face climate change in the Pandemic Covid-19 situation as this issue has been notable and the most significant in 2021.

CONCLUSION

This chapter concludes that Small Medium-sized Enterprises (SMEs) have an essential role in being the backbone of economic resilience, especially in developing countries. They contribute to the GDP, and many supports were given from Government and third parties to help SMEs become sustainable firms. Like a coin, the rise of SMEs productivity caused the increase in carbon dioxide emissions, global pollution, and the rise of demand and supply from the raw material. The SMEs ignore the waste disposal, air pollution, single-hand used plastic consumption, or renewable energy that consider climate change. In 2021, many SMEs are trying to reduce their footprint in the environmental section by applying green practices and strategies. It is because SMEs are also the human-agent of halting climate change. SMEs' benefits concerning this are that they gain competitive advantage anew in emerging market opportunities, an early mover advantage in the market, managing cost and risk, and environmental stewardship. Most of the SMEs adjust to the Sustainable Development Goals. They also adopt innovation and organizational learning as the internal factor while good support of Government is considered the external factor. These two factors can have a positive influence on the financial factor and build sustainable SMEs significantly.

REFERENCES

- Abisuga-Oyekunle, O. A., Patra, S. K., & Muchie, M. (2020). SMEs in sustainable development: Their role in poverty reduction and employment generation in sub-Saharan Africa. *African Journal of Science, Technology, Innovation and Development*, 12(4), 405–419. doi:10.1080/20421338.2019.1656428
- Africa Economic Outlook. (2014). *Global Value Chains and Africa's Industrialisation. Pocket Edition*. OECD Development Centre.
- Ahmed, M. (2020). Introduction to Modern Climate Change. Andrew E. Dessler: Cambridge University Press, 2011, 252 pp, ISBN-10: 0521173159. *The Science of the Total Environment*, 734(May), 139397. doi:10.1016/j.scitotenv.2020.139397
- Albritton, D. (1992). Economic issues in global climate change. In J. Reilly & M. Anderson (Eds.), *Global Environmental Change* (Vol. 2, Issue 3, pp. 3–23). Routledge Taylor and Franchise. doi:10.1016/0959-3780(92)90004-Q
- Berchicci, L. (2014). Innovating for sustainability. In *Chemistry & Industry* (Vol. 78, Issue 1). doi:10.1002/cind.781_6.x
- BPS-Statistic Indonesia. (2021). *Statistical Yearbook of Indonesia 2021*. Author.
- BRITA UK. (2019). *British SMEs struggling to reduce single-use plastics, survey finds*. <https://www.medicalplasticsnews.com/news/british-smes-struggling-to-reduce-single-use-plastics-survey/>

Climate Change and the Sustainable Small and Medium-Sized Enterprises

- Canaan, S. P. (2011). *The Determinants of Expansion of SMEs*. The Economic Research Forum.
- Demirel, P., Li, Q. C., Rentocchini, F., & Tamvada, J. P. (2019). Born to be green: New insights into the economics and management of green entrepreneurship. *Small Business Economics*, 52(4), 759–771. doi:10.1007/11187-017-9933-z
- Doh, S., & Kim, B. (2014). Government support for SME innovations in the regional industries: The case of government financial support program in South Korea. *Research Policy*, 43(9), 1557–1569. doi:10.1016/j.respol.2014.05.001
- EU SME center. (2019). SMEs in China: Policy. *Environment Reporter*, 22(July). http://www.stats.gov.cn/tjsj/tjbz/201801/t20180103_1569357.html
- Georgieva, K. (2009). The role of the sun in climate change. *IOP Conference Series. Earth and Environmental Science*, 6(9), 092016. doi:10.1088/1755-1307/6/9/092016
- Goel, R. (2020). Renewable Energy Startups and SME. doi:10.20944/preprints202008.0488.v1
- Hadj, T. B. (2020). Effects of corporate social responsibility towards stakeholders and environmental management on responsible innovation and competitiveness. *Journal of Cleaner Production*, 250, 119490. doi:10.1016/j.jclepro.2019.119490
- Hamann, R., Smith, J., Tashman, P., & Marshall, R. S. (2017). Why Do SMEs Go Green? An Analysis of Wine Firms in South Africa. *Business & Society*, 56(1), 23–56. doi:10.1177/0007650315575106
- Helmer, M., & Hilhorst, D. (2006). Natural disasters and climate change. In *Disasters* (Vol. 30, Issue 1). doi:10.1111/j.1467-9523.2006.00302.x
- Intergovernmental Panel on Climate Change. (2001). *Climatic Change*. Author.
- Kannan, R., & Boie, W. (2003). Energy management practices in SME - Case study of a bakery in Germany. *Energy Conversion and Management*, 44(6), 945–959. doi:10.1016/S0196-8904(02)00079-1
- Karadag, H. (2015). The Role and Challenges of Small and Medium-sized Enterprises (SMEs) in Emerging Economies: An Analysis from Turkey. *Business and Management Studies*, 1(2), 179. doi:10.11114/bms.v1i2.1049
- Maksum, I. R., Sri Rahayu, A. Y., & Kusumawardhani, D. (2020). A social enterprise approach to empowering micro, small and medium enterprises (SMEs) in Indonesia. *Journal of Open Innovation*, 6(3), 50. Advance online publication. doi:10.3390/joitmc6030050
- Marushevskiy, G., & Hickman, D. (2017). *Green Business for Small and Medium-Size*. Academic Press.
- Ministry of Cooperatives and Small and Medium Enterprises of the Republic of Indonesia. (2018). SMEs. *Data*, 2015–2018. <http://www.depkop.go.id/data-umkm>
- Nulkar, G. (2014). SMEs and Environmental Performance – A Framework for Green Business Strategies. *Procedia: Social and Behavioral Sciences*, 133, 130–140. doi:10.1016/j.sbspro.2014.04.177
- OECD. (2018). *SME and Entrepreneurship Policy in Indonesia 2018*. OECD.

Praditya, I. (2017). *Pertumbuhan Ekonomi di Indonesia Melambat, Ini Buktinya*. Liputan 6.Com. <https://www.liputan6.com/bisnis/read/4018038/pertumbuhan-ekonomi-indonesia-melambat-ini-buktinya>

Qiu, L., Jie, X., Wang, Y., & Zhao, M. (2020). Green product innovation, green dynamic capability, and competitive advantage: Evidence from Chinese manufacturing enterprises. *Corporate Social Responsibility and Environmental Management*, 27(1), 146–165. doi:10.1002/csr.1780

Rubio-Mozos, E., García-Muiña, F. E., & Fuentes-Moraleda, L. (2019). Rethinking 21st-century businesses: An approach to fourth sector SMEs in their transition to a sustainable model committed to SDGs. *Sustainability (Switzerland)*, 11(20), 1–23. doi:10.3390/u11205569

Takouleu, J. M. (2021). *AFRICA: Grino to work with Africa GreenTec for solar water treatment*. Afrik21. <https://www.afrik21.africa/en/africa-grino-to-work-with-africa-greentec-for-solar-water-treatment/>

The Jakarta Post. (2019). Investree, Java Mountain Coffee continues a “green financing” partnership. *The Jakarta Post*. <https://www.thejakartapost.com/travel/2019/09/23/investree-java-mountain-coffee-continue-green-financing-partnership.html>

United Nation. (2021). *The Sustainability Development Agenda*. <https://www.un.org/sustainabledevelopment/development-agenda/>

VOA Indonesia. (2019). *Wirausaha Sosial, Trend Bisnis Anak Muda*. Voa Indonesia. <https://www.voaindonesia.com/a/wirausaha-sosial-tren-bisnis-anak-muda/5171829.html>

ADDITIONAL READING

Albritton, D. (1992). Economic issues in global climate change. In J. Reilly & M. Anderson (Eds.), *Global Environmental Change* (Vol. 2, Issue 3, pp. 3–23). Routledge Taylor and Franchise. doi:10.1016/0959-3780(92)90004-Q

Apostolopoulos, N., Al-Dajani, H., Holt, D., Jones, P., & Newbery, R. (2018). Entrepreneurship and sustainable development goals. *Contemporary Issues in Entrepreneurship Research*, 8, 1–7. doi:10.1108/S2040-724620180000008005

Berchicci, L. (2014). Innovating for sustainability. In *Chemistry & Industry* (Vol. 78, Issue 1). doi:10.1002/cind.781_6.x

Goel, R. (2020). Renewable Energy Start-ups and SME. August, 1–10. doi:10.20944/preprints202008.0488.v1

Hadj, T. B. (2020). Effects of corporate social responsibility towards stakeholders and environmental management on responsible innovation and competitiveness. *Journal of Cleaner Production*, 250, 119490. doi:10.1016/j.jclepro.2019.119490

Nulkar, G. (2014). SMEs and Environmental Performance – A Framework for Green Business Strategies. *Procedia: Social and Behavioral Sciences*, 133, 130–140. doi:10.1016/j.sbspro.2014.04.177

Climate Change and the Sustainable Small and Medium-Sized Enterprises

Ratten, V. (2018). Sustainable entrepreneurship in cities. *Entrepreneurship, Innovation and Smart Cities*, 67–82. doi:10.4324/9781315407463-5

Rubio-Mozos, E., García-Muiña, F. E., & Fuentes-Moraleda, L. (2019). Rethinking 21st-century businesses: An approach to fourth sector SMEs in their transition to a sustainable model committed to SDGs. *Sustainability (Switzerland)*, 11(20), 1–23. doi:10.3390/u11205569

KEY TERMS AND DEFINITIONS

Eco-Adopter: The SMEs that start to adopt practices, strategies, and business models related to the SDGs movement.

Eco-Entrepreneur: The SMEs that start to focus on eco-friendly products that are interested in the existed market.

Eco-Innovator: The SMEs will invent a business breakthrough that is fully committed to preserving the environment and halt climate change.

Green Practice: A set of daily practices and principles implemented in being aware and supporting the environmental preserve.

Green Strategy: A set of goals and plans of achieving Sustainable Development Goals in 2030.

Start-Up: A new model of SMEs that concern with taking a business on a digital platform.

Sustainable Development Goals (SDGs): An environmental movement created by the United Nations in 2015 to focus on the preservation and improvement of people, the planet, and prosperity.

Chapter 12

Climate Change and Insurance Business in Developing Economies

Olusola Olawale Olarewaju

University of KwaZulu-Natal, South Africa

Bomi Cyril Nomlala

University of KwaZulu-Natal, South Africa

ABSTRACT

The capacity of insurance systems to reduce immediate losses caused by disasters through the provision of financial security against extreme weather conditions such as hurricanes, tropical cyclones, droughts, and floods avails an opportunity to developing countries for reduction of poverty and steady economic growth. The process of negotiating premium creates a platform for incentives to reduce risk and adapt to the climate change. There are opportunities for donors to combine resources so as to support the vulnerable communities with measures to reduce risk. In this research work, the scholar examines the process of financing disaster risk in developing countries, insurance of disaster in developing economy, advantages of disaster insurance, cost and risks involved in the insurance business, the concept of adaptation in insurance system, proposal of the Munich climate insurance initiative, the impact of insurance on the reduction of greenhouse gasses, and the globalisation of climate change risk.

CLIMATE CHANGE AND INSURANCE BUSINESS IN DEVELOPING ECONOMY

The impact of climate change generates intense and more frequent natural disasters such as destruction of business environments and homes at outrageous rates. These occurrences exert risk on the food system in a particular nation. According to McKinsey and Company (2020), the economic havoc caused by hurricane Harvey in 2017 was approximately \$125 billion while the Australian bushfires in 2019 destroyed several animals which led to loss of \$4.4 billion in damage. The issue of climate change is a prominent problem poised against insurance business across the globe. Insurance business is one of the

DOI: 10.4018/978-1-7998-7967-1.ch012

Climate Change and Insurance Business in Developing Economies

largest financial sectors in the world as everyone endeavour to secure their pivotal lives and possession. The roles of the insurance sector in an economy is not to be undermined as it reimburses the insured from loses on properties, health, crops, life and myriads of loses from basic parts of life. It is expedient to reveal that further changes in the universal climate are presumed to occur in the next ten years. Hence, the concern of insurance business is no longer individual catastrophic occurrences but the relationship between human system and global climate. Insurance business can generally be referred to as an activity of a provision against losses.

According to Jarzabkowski, Chalkias, Clarke and Iyahan (2019), Insurance business produces capital flow to promote recovery of societies from disasters. Also, the application of insurance delivers financial resilience. Obviously, the absence of suitable insurance enables the burden of losses to fall largely on governments, citizens and organisations. Insurance is a non-monolithic business with quite a considerable regional variation in coverage of risks, exposure to damages and rendering of services within and among countries. This business partakes in a public-private patch work for the spread of risk across societies, properties, lives, possessions and a large geographical zone. Insurance is the result of a man's effort to mitigate financial problems in the face of dangers to his life, person and estate (LAWSA, 2018). According to Patankar and Patwardhan (2016), insurance provides adequate financial security to reduce setbacks to economic, societal and technological advancements. Hence, it's a tool for safeguarding a society's developmental gains.

After much emphasis on insurance from varying scholars, there is a need for an exaggeration of climate change and its impact on this business. For maximum efficacy, insurance needs to be included in a long-term, broad climate adaptation strategy. Climate adaptation involves the reduction of vulnerability to hazard and the delivery of systems to respond and recover and financial resilience to the remaining risks. Climate change is altering weather patterns and increasing the intensity of adverse weather condition. It may be a cause of adverse weather condition like flooding, hail and drought. The effects of climate change are systematic considering the adverse impact on local economies and impending market failures which are directly linked to consumers and insurers. More so, incessant catastrophic events in relation to meeting regulatory requirements can threaten the firms' business models and increase the cost of insuring certain risk. The effects of climate change on risks insurance hasn't gone unnoticed as the world is plagued by one or another climate change abrupt condition, climate change variation creates risks to a policy holder's insurable asset and a further problem of how to underwrite the problem brought about by this situation. It can be further stated that climate change displays both financial and management threat on insurance business across the globe.

The amount paid out by insurance industries for weather related disasters in the developing nations are three times the amount made available by international aid (Evans, 2004). Climate change will increase variability, intensity and frequencies of weather related problems(IPCC,2007).This can be said to occur because of land use and increasing settlement of people in weather catastrophic regions, a basic example is the coastal regions are affected by windstorm while fertile river basins are vulnerable to floods. King (2018) has attributed the cause of climate change disrupt to greenhouse gasses emission from the developed nation affecting the developing nation or basically its neighbouring nations and therefore demand for payment of damages by these developed economy as a basic compensation and to encourage the developing nations to create an interest in protecting themselves against global warming and its effects.

According to IPCC (2014), since the pre-industrial period there has been an increase in gas house emission, this activity is driven by economic and population growth and are recognised as high as ever in recent times. On the other hand, the effect of gas house emission drivers and other emission has been

detected and can be concluded to be a particular caused of climate change happenings and its variability. However, risks policy varies across geographical locations depending on the weather-related issues encountered in each country, expectation and variety of industry experiences on past occurrences. On this fact, the world's major climate foreseeing centres predicts that if current rates of greenhouse gas are well maintained dangerous rates of global warming will decline. In other words, we can state that if climate change causes attributed to gas emissions and other sources which can be well controlled can be maintained, insurance business can be profitable by cutting on all costs.

One of the leading greenhouse gas emitter among the developing economies has its greenhouse emission growing at 0.22 percent annually. Climate change and weather variability has been a major issue poised at insurance business in developing countries over the years (USAID, 2017). Developing countries are very vulnerable to impacts of climate change in their regions. Their residences in the rural area are affected by the frequency of drought and flood. For instance, as confirmed by department of water (2013), water is the primary medium in which climate change affects South Africa.

As climate change continue to raise global temperature severely and create unpredictable weather events, it is said to have prominent and significant impact on property insurance as the year goes by and risk management cost and its policy holders expands. (Cardenas, Hochrainer, Mechler, Pflug, & Linnerooth-Bayer 2007). Climate change occurrences costs south Africa 10 to 20 percent of its gross domestic product while countries like Nigeria pays closely 29 percent and India suffers 30percent.on the other hand, global inequality can equally be traced to global warming where the developed nations benefit from global warming due to their cold weather (king,2019).

The increasing frequency and severity of natural event will force insurers to evaluate loses and this may eventually result into a strategy change for certain insurer, provided that this frequency and severity becomes extreme and relatively out of control insurers will be forced to re-evaluate the viability of insurance policy secured beforehand. However, insurance business has suffered some setback in developing nations of the world with increasing and outrageous risks being considered by the insurers. Sometimes, there are needs for re-insurance of the insurers which may necessitate further cost being incurred by the firm. For example, the industry in South Africa recorded six significant catastrophic happenings. A problem taken into record as of this period was the increasing frequency of hailstorms leading to damages in built up zones leading to motor and portfolio losses. Furthermore, another climate change catastrophe in the same year was the occurrence of electrical storm in the Highveld area especially in a certain part of Pretoria leading to increase in lightning damages and fire occurrences leading to increase to loses of lives and loses of possessions.

In 2013, the insurance business was poised with further losses resulting from climate change severity. A major hailstorm occurred across most areas of Gauteng. These losses were beyond the recorded losses in the previous year's hailstorm occurrence (Vazeer, 2016). Vazeer, (2016) further emphasized that high winds and arid landscapes caused an abrupt fire rage in the cape region of the country in 2014. Moreover, this year was plagued by little climate change effect which prompted lesser losses incurred and lesser risks spread among the incurred. This can be considered a good upturn for the business in this period considered. Kynysna and its regions were ravaged by a wild fire outbreak in 2017 and this event was reciprocated by a heavy flood in Durban causing uproar in less than 6 months after the former occurred and a higher cost incurred by the government and the insurance institute.

Insurance system in developing countries has responded quite effective to climatic extremes and variability in recent decades by increasing flexibility towards property policies and other weather-related policies. The industry has tried as much to create a variety of policies that can encourage the insured

Climate Change and Insurance Business in Developing Economies

and increase the number of the insured in the region towards the profitability of the business. Lately, a major uproar on the increasing volatility of the rising number of climate change problems costs the world over 520 billion dollars annually leading to 26 million people poverty and poverty trapped life. On the other hand, a major implication of this problem on the insurance business will lead to a lesser number of interests towards property insurance as a result of income constraint. A major cause of the increase in poverty trap as a result of climate change occurrence is the aftermath impact of this natural disaster on economic growth which can be termed as 'inflation'. More so, Basic findings has affirmed that the cost to be implemented by the government of several nations on the resistance and avoidance of these cost would amount to an additional cost of 3% of gross domestic product (GDP) and in two decades (20 years) the government and the insurance industry stands to spend a total of 3 trillion dollars.

This research looks to study the impact of the climate change hazards inflicting developing nations of the world in relation to its insurance industry restraining strategy and opportunities in these happenings as well.

STATEMENT OF PROBLEM

Climate change is obnoxious to every part of human life. Every nation across the globe is affected by the suffering inflicted upon its environment by the varying occurrence of natural disasters which may include flood, hailstorm, hurricanes, mudflows, landslides etc. A major cause of these natural occurrences can be traced to the excessive use of substances that can lead to environmental degradation. Hence; loss of lives and properties for those around the areas affected. Africa being the home of developing nations is one of the top continents with the highest number of carbon-oxide emission. Gas usage and emission is pertinent to most developing nations as they look to build a carbon economy where the rate of gaseous emission determine a proportion of the economic growth a country eventually has.

One of the substances leading to this degradation is the greenhouse gas emission common in most developing economy. The major greenhouse gas emission into the atmosphere have risen rapid over the years crossing the benchmark of 400 parts per million. The impact of developing countries to global greenhouse gas emissions is large and its share will grow potentially over time with an aim of eradicating through social and economic development of atmospheric concentration. In recent years, concern has grown over the issue of global climate change caused by increased accumulations of greenhouse gases. The insurance industry can no longer assess risk based on past happenings and exposure but has to look to expectations from future occurrences. If the industry will assess the risks thereof there is a need for accurate scientific knowledge and tools for predicting expectations in the future which may be relatively expensive depending on the size of the happening. if the insurance industry is to assess risk related to climate change and variability reliably there is a need for comprehensive scientific knowledge which may be costly to inculcate or spread.

The problems poised to countries on the issue of climate change and variability cannot be undermined when being considered. Furthermore, one of the problems include the changing insurance policies being issued to the insured. This may be as a result of migration or change in environmental condition or disaster. A basic effect of this is the increase in the price (premium) for insurance that is, as insurance policy changes the premium also change (rise or fall). more so, it can be acknowledged that in some cases weather related insurance losses will rise faster than premium(cost) and economic growth in some climate change affected regions (Mill, 2005). Insurance business measures the probability that an event

will occur. Hence, risk can be described as uncertainty to be measured for an event to occur. Since the insurance industry has vast experience in measuring uncertainty in happenings, it is assumed to be proper when plagued by uncertainty of climate change. More so, the business experiences fluctuations depending on the frequency of weather extremes which are expected to change with time and geographical location as well as the damages and cost incurred during the occurrence of the event.

Sometimes, due to increasing uncertainty in some residential areas, residence may face a threat of massive investment in adaptation as it can be confirmed that the beautiful a geographical area the more uncertain the situation (Herweijer, Nicola and ward, 2009). So, there will be a low range of investment in property, livestock and other agricultural products which may on the other hand have an adverse effect on insurance business profitability where there are lesser things to insure. This research paper looks further to evaluate these problems and proffer a variety of solution and create a significant policy which will have an impact on climate change effects and opportunities in South Africa and other related regions.

FINANCING DISASTER RISK IN DEVELOPING COUNTRIES

Insurance instruments are basically one of the activities engaged in the process of managing risks associated with natural hazards. The uppermost priority of risk management is investment in prevention of economic and human losses (Linnerooth, Warner, Bals, Hoppe, Burton, Loster & Haas, 2009). The various forms of disaster prevention and mitigation are reduction in risk exposure, vulnerability reduction and creation of institutions for a prompt response. Individuals and businesses depend on public assistance after the occurrence of disaster instead of insurance in high income nations. The government of United States of America provides adequate help to private victims. Also, insurance does not practically exist in least developed nations of the world and assistance from the public office is far lower. For instance, after the flooding disaster in Sudan, it was the victims that absorbed larger percent of the losses. Farmers, households and governments in developing nations of the world have different means of financing losses after disasters such as sale of assets and lands, emergency loan from associates, money lenders and credit institutions (Warner, Bouwer & Ammann, 2007). Similarly, governments sometimes finance losses as a result of post-disaster activities by raising capital through diversion of funds from other budgets, borrowing of funds internally and loans from international organization. Individuals can set up mutual arrangements before the occurrence of the disaster with friends and family. In addition, governments can temporarily spread risks by reserving some funds in regional pools or contingent credit arrangements. However, these methods of financing losses can be less expensive, more accessible and affordable to low-income earners and government. Though, financing informally may perform well for losses which are not much but very inadequate and unreliable for disastrous events (Cohen & Sebstad, 2003). Failure to access affordable and sufficient capital so as to sustain recovery process in highly susceptible nations of the world is the reason for climate adaptation regime and donor organizations, and to aid insurance programmes. The idea of moving from post-disaster support programme to providing pre-disaster security via insurance instruments also benefits the donors (Warner et al. 2007). Consequently, insurance instruments enhance strong incentives to reduce risks and thereby reduces the necessity of external aid.

INSURANCE OF DISASTER IN DEVELOPING COUNTRIES

Basically, International financial institutions and contributors are gradually supporting insurance business in developing countries (Linnerooth, Mechler & Pflug 2005). There are new programmes introduced which are very creative in nature to provide insurance for SMEs, farmers and property owners and also transfer of risk confronting government to international capital markets such as livestock insurance in Malawi, index-based crop (Suarez, Linnerooth & Mechler, 2007), insurance of property in Turkey (Gurenko, Lester & Mahul, 2006) and issuance of catastrophe bond by the Mexican government (Cardenas, Hochrainer, Mechler, Pflug & Linnerooth 2007). These insurance listed programmes and some other insurance systems supported by donor are still in their pilot stages in most developing countries such as South Africa since they have not been tested by devastating event. Therefore, assessing the effectiveness of such systems in combating economic distress might be too early. It is imperative to ask if developing nations of the world should also adopt the insurance systems of developed countries in insuring huge disasters or find out the most appropriate insurance instrument to tackle rising cases of natural disasters?

ADVANTAGES OF DISASTER INSURANCE

The provision of adequate access to post-disaster support funds by low-income farmers, households and businesses is an opportunity to secure their source of revenue, reduce the impacts of such disasters and accelerate the process of recovery. Likewise, insurance agreement is more secured and dignified than relying on supports from donors. Insurance promotes creditworthiness and investment in assets with high rates of returns. The engagement of insurance contracts offers motivations to reduce risk. The insurance instruments in the government sector reduces the risk associated with post-disaster financial inadequacies and prompt repairs of public infrastructure and delivery of relief expenditures. Similar to preventive measures on occurrence of disaster, prompt repairs and relief can safe guide livelihoods and avert disaster-induced poverty traps.

COST AND RISKS INVOLVED IN INSURANCE BUSINESS

There are quite a number of risks involved in insurance business considering the experiences in both developing and developed nations of the world. These risks are classified as;

- Stability, trust and public confidence in the institutions.
- Impending collapse and non-sustainability of insurance systems
- Moral threat, contrary selection and basis risk.

Obviously, where the regulatory framework is weak, micro-insurance businesses transacting in low-income areas lack backup capital and are prone to liquidation risks (Mechler, Hochrainer and Linnerooth, 2006). The liquidation risks are reduced by reinforcing regulatory framework in the market and external support of the system. For instance, a contingent credit facility was introduced by the World Bank to support Turkish Catastrophe Insurance Pool which is positioned to cover earthquake occurrence risks before the payment of premium (Gurenko et al 2006). Public confidence and trust will be boosted by

this kind of support. More so, the act of setting up index-based systems will resolve the issues of moral threat. For instance, insurance claims by farmers in Malawi pilot micro-insurance contract are activated by precipitation dropping below a set level as measured by local weather stations. Institutional trust and stability is basically a challenge in developing countries. Obviously, lack of trust is a limiting factor in up-scaling insurance systems outside the donor-supported pilot phases.

Consequently, the impacts of insurance enhance its inclusion as a potential integral aspect of a global disaster risk management strategy. Nonetheless, these impacts can be expensive. For instance, insurance business which covers co-variant risks are confronted with massive and stochastic losses. Hence, there must be sufficient capital reserves to cover the losses, diversification or reinsurance purchase which are basically part of the premium. Provision of insurance on a small scale includes high costs such as administration cost, estimating and underwriting risks cost and handling cost. Frictional costs are costs which are resulted from informational asymmetries between management of insurance business and capital market (Cummins & Mahul, 2008). This is evident as global capital markets are not well informed about the insurance business exposure to disastrous risk and the sufficiency of the reserves meant to cover losses than the organization's manager. It is possible for the capital market to charge a higher cost of capital for information gap. In addition to the challenge posed by irregular information, insurance firms may overstate the premium to cover ambiguity and uncertainty.

INSURANCE SYSTEM AND ADAPTATION

The justification for the inclusion of insurance in climate change does not depend only on the failure of the market in serving the most exposed, but on the premise that the system which aids countries and individuals recover from extreme climate change can lessen the impacts of these events (Hoff, Warner & Bouwer, 2005). This is called adaptation in the climate system. Adaptation involves enhancements in physical systems such as protection against flood or early warning systems, social system shifts such as change of livelihoods and alleviating underlying vulnerabilities such as advancing productivity to encourage savings as a relief for future disasters. Insurance system is capable of promoting the activities of disaster risk reduction by provision of premium reductions and related incentives to reduce risks, compilation of insurance support with risk reduction requirements and stimulating productivity which facilitates long-term reduction in losses.

Reduction of Risk through Incentives: Insurance system has the capacity to decrease direct and immediate losses caused by disaster through incentives for pre-disaster alleviation measures. The introduction of seasonal rainfall forecasts to provide farmers in Malawi inducements to reduce losses caused by drought on crops. This special scheme is referred to as drought micro-insurance scheme in Malawi (Suarez et al 2007). It helps farmers to select a drought-resistant crop variety or be involved in high-yield practices of farming.

Combination of Insurance System with Risk Reduction: A better way to promote adaptation is the process of making insurance provision conditional on risk reduction measures. This instance is applicable in the U.S National Food Insurance Programme whereby land-use and some other measures are set aside by communities for residents to be qualified for subsidised insurance policies (Kunreuther, 2006). However, this principle is applicable to donor assistance which occasionally switch from project-oriented aid to direct cash transfers to the less privileged. The transfers are conditional on the beneficiaries purchasing insurance.

Insurance for Enhancing Productivity and Adaptation: Insurance that is well designed is capable of promoting investments which aids productivity and adaptation. Considering the illustration of drought micro-insurance in Malawi, the pilot scheme packages the insurance system with credit which allows farmers to buy more productive seeds. The idea of doubling cash crop during the pleasant seasons enables farmers to save cash for the dried years characterised by drought and lesser productivity.

MUNICH CLIMATE INSURANCE INITIATIVE (MCII) PROPOSAL

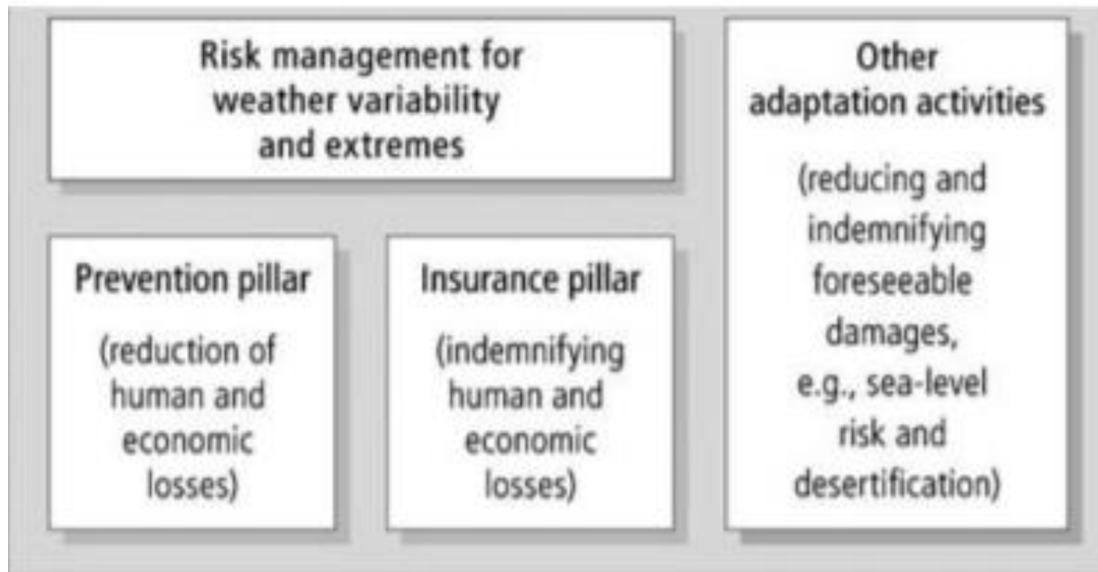
The inability of the private sector to solely provide products that will comprehensively proffer solution to the vulnerable businesses, households and government affected by climate change fuels the creation of development organizations and climate community positioned to aid developing nations in adapting to climate change. The concept of insurance system as a fragment of the adaptation plan has an historical base in the climate change debates. The major concerns and demands of developing nations of the world as a result of the adverse effects of climate change were addressed in the article 4.8 of United Nations Framework Convention on climate change (United Nations, 1992). Also, establishment and consideration for insurance was discussed in Article 3.14 of the Kyoto Protocol (United Nations, 1997). However, the AOSIS proposal outlined with reasonable arguments the meaning of an uninsurable risk that requires little responsibility from the victims (AOSIS, 2008). Climate change and other related activities were positioned to be funded by AOSIS proposal, nonetheless there were arguments suggesting that adaptation should be determined by the level of poverty and vulnerability (Kantha, Bhandari, Schaik, Cornland & Kjellen, 2006). Apparently, it is expected that the developed nations of the world should be responsible for funding adaptation while the beneficiaries will be in developing countries.

Subsequently, there are emergence of different proposals on the disbursement of adaptation funds. For instance, the suggestion of the Swiss to COP12 in Nairobi which projected that revenues that are generated from a global carbon levy should be channelled into two categories of funds. These funds are Multilateral Adaptation Fund and National Climate Change Funds. The multilateral adaptation funds would be disbursed on two pillars namely insurance and prevention. According to the suggestion of the Swiss, the MCII has projected the operation and design of a climate risk management module which includes insurance (MCII, 2008). The pillars are necessitated to lessen human and economic challenges of intense climate change conditions on developing countries. Hence, the prevention pillar of the proposal will promote professional guidance and financial means to reduce losses from extreme climate change and variability. The essence of the prevention pillar is to facilitate investments in decreasing losses resulting from variability and extreme climate change (UNFCCC, 2007). Whereas, the insurance pillar of the MCII proposal comprises of two tiers showing the risk layers to be addressed for real adaptation:

High Level Risk: This level of risk surpasses the capacity of any nation to pay in the event of extreme disaster.

Middle Level Risk: This level is within the capacity of any nation to withstand so far adequate enabling framework is on ground.

Figure 1. The MCII proposed climate risk management module



THE IMPACT OF INSURANCE ON THE REDUCTION OF GREENHOUSE GASES

The insurance companies globally are endorsing strategies to reduce greenhouse gas emissions so as to combat the threats of global warming. Some of such strategies include issuance of public warnings to general populace and policy makers in the organizations, adoption of public instructions on global warming and the environment and alliance with private organizations and the respective government to enact laws to reduce greenhouse gas. More so, there are increasing awareness through the establishment of specific units by companies to organise initiatives on global warming. A good number of reinsurance companies are involved in sponsorship of research activities on adaptation to extreme weather conditions in developing nations of the world. Major contribution to renewable energy projects and reforestation to ease greenhouse gas emissions is a remarkable commitment executed by many insurance companies in the developing countries. Some of the in-house efforts of insurance companies are paperless billings and upgrade of web sites to enable electronic transactions. There are plans by insurance companies to reduce cost of property damage and incidence caused by extreme weather conditions. There exist great uncertainties on the likely effect of global warming on property losses. There are assumptions by scholars that precipitation is more unpredictable and extreme thereby resulting to hotter and drier environment which might trigger wildfires and rainstorms in some areas. However, losses on property such as structural damages, direct property damage and extra expenditure on either relocation or reconstruction are considered by insurance companies. Apparently, there are increasing incident of catastrophes which are destructive while losses that are insured rise by virtue of inflation and natural disasters.

THE GLOBALIZATION OF CLIMATE CHANGE RISK

Majority of the cases of effects of climate change are viewed from natural disaster with minimal investigation on the economic implications. Hence, property losses as a result of weather related disasters are on the increase, underwriting becomes difficult and insured share rises. Organizations are confronted with environmental litigations rising from emission of greenhouse gas and lack of compliance with rules (Allen & Lord, 2004). Consequently, losses relating to life and health emerges in the insurance industry as a result of the climate change. These losses are caused by thermal extremes, shortage of quality water, rising cases of vector-borne disease, pollution of air, food poisoning and mental effects (World Health Organization, 2003). The pooled effect of rising losses, depletion on reserves, reconstruction costs inflation after natural disasters and increasing cost of risk capital are primarily reasons for prolong losses in the insurance industry.

RECOMMENDATION

Insurance system provides an avenue for the recovery process in the event of disastrous events. Hence, accessibility and affordability of capital by insurance companies to cushion the recovery process in susceptible countries is very necessary. The intention to shift focus from post-disaster support initiative to pre-disaster security via insurance strategies is beneficial to households, businesses, and the government. Therefore, adequate attention should be given to pre-disaster security measures to avert devastating losses. Rapid response to repairs and reconstruction of public infrastructure to guide against disaster-induced poverty traps and loss of livelihoods is very important. Hence, provision of timely relief expenditure by insurance companies.

CONCLUSION

Considering the enormous adverse impacts of climate change on households, businesses and government, insurance industry without the alliance of other stakeholders will be unable to offer services for creation of adequate safety and cover for the poor countries to cope with natural disasters. Similarly, it is practically impossible for the insurance industry to solely resolve all adaptation challenges with growing climate risks. Hitherto, insurance industry, international support, government and Non-government organization are capable of providing financial support against floods, droughts, rainstorms, tropical cyclones and other related extreme weather activities affecting developing countries. The support of international communities to the insurance industry will definitely be a fortified complementary tool in a wider adaptation framework. Insurance industry provides vulnerable developing countries and governments protection against the consequences of climate change and disasters, and supports productive investments that decreases their vulnerability. More so, high cost implications associated with disaster cover can be excessive for low-income clients and related risks for local providers of cover for systemic risks. The Munich climate insurance initiative (MCII) Proposal which involves an insurance pillar is capable of handling the problems associated with provision of support to enhance reasonable, sustainable and incentive-compatible insurance system with little crowding out of private sector participation. The

creation of insurance for the poor drives opportunities to transfer risk with the inclusion of the private market.

REFERENCES

- Alliance of Small Island States (AOSIS). (2008). Proposal to the Ad Hoc Working Group on Long-Term Cooperative Action Under the Convention (AWG-LCA). In *Multi-Window Mechanism to Address Loss and Damage from Climate Change Impacts*. UNFCCC. unfccc.int/files/kyoto_protocol/application/pdf/aosisinsurance061208.pdf
- Cardenas, V., Hochrainer, S., Mechler, R., Pflug, G., & Linnerooth-Bayer, J. (2007). Sovereign financial disaster risk management: The case of Mexico. *Environmental Hazards*, 7(1), 40–53. doi:10.1016/j.envhaz.2007.04.005
- Cliffe, D. (2014). Best Practices for When s* IT Hits the Fan. 9. In *Climate change and human health: Risks and responses*. World Health Organization.
- Cummins, D., & Mahul, O. (2008). *Catastrophe Risk Financing in Developing Countries: Principles for Public Intervention*. World Bank. doi:10.1596/978-0-8213-7736-9
- Evans, C. D., Monteith, D. T., & Cooper, D. M. (2005). Long-term increases in surface water dissolved organic carbon: Observations, possible causes and environmental impacts. *Environmental Pollution*, 137(1), 55–71. doi:10.1016/j.envpol.2004.12.031 PMID:15944040
- Evans, G. W. (2004). The environment of childhood poverty. *The American Psychologist*, 59(2), 77–92. doi:10.1037/0003-066X.59.2.77 PMID:14992634
- Gurenko, E., Lester, R., & Mahul, O. (2006). *Earthquake Insurance in Turkey: History of the Turkish Catastrophe Insurance Pool*. World Bank Publications. doi:10.1596/978-0-8213-6583-0
- Herweijer, C., Ranger, N., & Ward, R. E. (2009). Adaptation to climate change: Threats and opportunities for the insurance industry. *The Geneva Papers on Risk and Insurance. Issues and Practice*, 34(3), 360–380. doi:10.1057/gpp.2009.13
- Hoff, H., Warner, K., & Bouwer, L. (2005). The role of financial services in climate adaptation in developing countries. *Deutsches Institut für Wirtschaftsforschung*, 74(2), 196–207.
- Kartha, S., Bhandari, P., van Schaik, L., Cornland, D., & Kjellen, B. (2006). *Adaptation as a strategic issue in the climate negotiations. European Climate Platform (ECP) Background paper no.4, European Climate Platform (ECP)*. Draft.
- Kunreuther, H. (2006). Disaster mitigation and insurance: Learning from Katrina. *American Academy of Political and Social Science*, 604(1), 206–227. doi:10.1177/0002716205285685
- Linnerooth-Bayer, J., Mechler, R., & Pflug, G. (2005). Refocusing disaster aid. *Science*, 309(5737), 1044–1046. doi:10.1126/science.1116783 PMID:16099976

Climate Change and Insurance Business in Developing Economies

- Linnerooth-Bayer, J., Warner, K., Bals, C., Höppe, P., Burton, I., Loster, T., & Haas, A. (2009). *Insurance, developing countries and climate change*. The Geneva Papers on Risk and Insurance-I.
- Mechler, R., Hochrainer, S., & Linnerooth-Bayer, J. (2006). Public sector financial vulnerability to disasters: The IIASA CATSIM model. In J. Birkmann (Ed.), *Measuring Vulnerability to Natural Hazards: Towards Disaster Resilient Societies*. UNU Press., doi:10.1057/gpp.2009.15
- Michaels, A., Close, A., Malmquist, D., & Knap, A. (1997). Climate science and insurance risk. *Nature*, 389(6648), 225–227. doi:10.1038/38378
- Mileti, D. (1999). *Disasters by design: A reassessment of natural hazards in the United States*. Joseph Henry Press.
- Mills, E. (2005). Insurance in a climate of change. *Science*, 309(5737), 1040–1044. doi:10.1126/science.1112121 PMID:16099975
- Suarez, P., Linnerooth-Bayer, J., & Mechler, R. (2007). *The Feasibility of Risk Financing Schemes for Climate Adaptation: The case of Malawi*. DEC-Research Group, Infrastructure and Environment Unit. The World Bank.
- UNFCCC. (2007). *Bali Action Plan*. unfccc.int/meetings/cop_13/items/4049.php
- United Nations. (1992). *United Nations framework convention on climate change* (unfccc/formal/89.E.05-6222OLE)00705.9. New York: UN.
- United Nations. (1997). *Kyoto protocol to the United Nations framework convention on climate change*. UN.
- Warner, K., Bouwer, L. M., & Ammann, W. (2007). Financial services and disaster risk finance: Examples from the community level. *Environmental Hazards*, 7, 32–39.

ENDNOTE

- ¹ Weather Catastrophes and Climate Change (Munchener Ruckversicherungs-Gesellschaft, Munich, 2005).

Chapter 13

Climate Change and Agricultural Sustainability in Nigeria: An Assessment of the Crop, Forestry, Fisheries, and Livestock Sub-Sectors

Eddiong Samuel Akpabio

Trinity University, Nigeria

Valentine Chidozie Udeh

University of Nigeria, Nsukka, Nigeria

Ifeanyi Emmanuel Uzochukwu

University of Nigeria, Nsukka, Nigeria

Nnanna Ephraim Ikeh

University of Nigeria, Nsukka, Nigeria

Ndubuisi Samuel Machebe

University of Nigeria, Nsukka, Nigeria

ABSTRACT

Climate change and agriculture are intertwined with one having significant impact on the other. Hence, taking cognizance of the relevance of agriculture to man's survival, it has become important to interrogate the effect of climate change on agricultural sustainability. This work therefore embarks on a sub-sectorial assessment of the agricultural sector in the face of rising threats due to climate change. Majorly, the agricultural sector is divided into four sub-sectors.

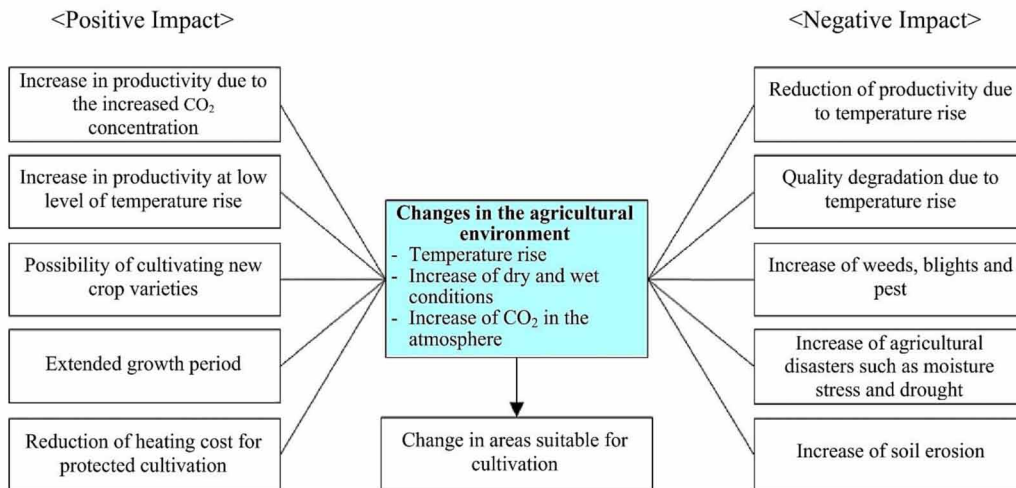
DOI: 10.4018/978-1-7998-7967-1.ch013

INTRODUCTION

Globally, climate change has negatively affected humanity and the environment (NASA, 2021), as a result, it will be apt to refer to it as one of the leading issues capable of causing human and environmental crisis in the 21st century (Debay, 2010). It is a global challenge whose impacts have been more noticeable in developing countries as these category of countries are more vulnerable than their developed counterparts (Ludwig et.al, 2007). Studies have shown that the agricultural sector has suffered more in terms of economic losses due to the size and sensitivity of its operations, as it has been predicted that climate change will negatively affect production of crops especially in low latitude countries (Folnovic, 2020). Agbola & Fayiga (2016) alluded to this position by stating that extreme climate events have often led to soil degradation and low yield of crops. This can be attributed to the nature of the agricultural industry, a weather-sensitive sector which is prone to disruption by climatic dysfunctionalities. Climate change which results in drought can lead to water scarcities hence resulting in low agricultural yield (Assaf, H et.al, 2012). There is also the danger of excessive rainfall which could cause heavy flooding thereby making the soil waterlogged and resulting into destruction of crops (Tabari, 2020). The impact of climate change on livestock production is detrimental because climate change poses serious threats to livestock production (FAO, 2020). Hence, livestock production suffers greatly in the event of climate variability. This development is not just a red flag to the sub-sector but could affect the entire agricultural industry. Therefore, there is a need to put in place adaptive strategies to save livestock cultivation.

Fish provides a rich source of protein to man and has been highly recommended by food nutritionist. However, about 60% of fishes risks going into extinction due to the negative impact of climate change on her habitat (World Economic Forum, 2020). Water bodies which is the natural dwelling place of fishes is prone to destruction and destabilization due to weather variations occasioned by climate change. Aquaculture is impacted by climate change because the intensity and frequency of extreme weather conditions cause material damage and flood freshwater farms (Climefish, 2020). The impact of climate change in developing countries is higher as most of such countries rely on firewood to cook their meals. This drives massive felling of trees resulting in deforestation and harm to the ecosystem. Forests and climate change are closely linked because forests could be a cause of climate change or its solution (Hoogeveen, 2020). To be more succinct, forests impact the climate to a very significant extent. The crucial role that forest plays in issues of climate change has made this study quite expedient due to the fact that while afforestation affects the climate positively, deforestation does so negatively that is why in developed regions of the world, forest resources have been utilized in mitigating the impact of climate change. This goes to show that proper management of the forest will help to solve the challenges of climate change that Nigeria is currently grappling with because as the forest changes, the climate follows suit.

Figure 1. Potential impacts of global warming on the agricultural sector
 Source: Kim, Chang-Gil and et al. (2009), p.38.



Climate change in recent years has assumed a worrisome dimension largely due to the fact that aside the rise in temperature, it adversely and tremendously affects the ecosystem which is key to the survival of humanity (Ecological Impacts of Climate Change, 2008). Preliminary investigations conducted have shown that man's activities are chiefly responsible for the rise in climatic levels (Slave & Carmen, 2012). For instance, practices such as deforestation without afforestation programs in place and burning of fossil fuels amongst others have continued to aggravate rather than ameliorate the climate change conundrum (Council on foreign Relations, 2009). Granted that climate change impacts on agricultural sustainability, studies have also shown that harmful agricultural practices can lead to climate change (Futurelearn, 2021). A handy example of such activity is land use change which can negatively affect the climate. It is however worthy of note that climate change is not a stand-alone activity as it comes with causes and corresponding effects. Food security in Africa has remained a mere wish as most states in the region suffer acute food shortages and insecurities and the Nigerian state is not excluded from this ugly tide because despite the enormous potentials she has, the nation has been unable to defeat the forces of food insecurity and entrench food security on her shores.

In most economies in Africa of which Nigeria is a significant part, agriculture not just plays a central role but contributes significantly to their Gross Domestic Product (GDP) (Chijioke et al., 2011). This is principally due to the fact that the mass of the people are engaged in this sector either for subsistence or commercial purposes. It is therefore worrisome to note that this critical sector has been affected by climate change (Lamboll & Nelson, 2012) with more untoward consequences in the offing if left unchecked. As climate change continues to accentuate in the country, there is the tendency for it to exacerbate current challenges faced in the agricultural industry hence, the need to launch an inquiry into the relationship between climate change and agricultural sustainability in Nigeria. Although the federal and state governments have set up panels with specific mandates of addressing these challenges, we are of the view that more needs to be done in order to stem this ugly tide. Granted that the effects

of climate change are global, it seems to be more felt in less developed climates. This could largely be attributed to the location of these developing countries in the tropics and also having temperatures that compromise agricultural production hence their sensitivity to climate change (Mendelsohn et al., 2006 & Kurukulasuriya et al., 2006). The underlying motivation behind this chapter is to evaluate the impacts of climate change on the forestry, crops, fishery and livestock sub-sectors of Nigeria's agricultural industry with a view to suggest feasible and plausible strategies to get her out of the woods and set the sector on a path of sustainability.

THE SAD TALE OF THE FOREST: DISCUSSING IMPLICATIONS OF CLIMATE DISORDER

The effect of climate change on the Nigerian forest cannot be overemphasized. Climate change poses a lot of challenges which range from rises in temperature, variability in rainfall pattern, rising sea levels, floods, erosion, drought, thunderstorms, lightning, bush fires, landslides, land degradation and loss of biodiversity (Olaniyi et al., 2019). An increase in the frequency and intensity of these disturbances causes a distortion in the forest ecological resilience and this results in a permanent alteration or shift to the non-forest ecosystem (Brack 2019). The resultant risks to forest species and ecosystem stability vary with location, time and they tend to react abruptly when a certain threshold is reached (FAO 2017). The effect of climate change on forests is not distinct but interconnected. This is due to the fact that one factor might lead to the other, below are some of the various ways climate change has impacted Nigerian forests

Most forest species have a climatic range in which they thrive (FAO 2017) and deviation from this will lead to migration of species, extinction, loss of habitats and/or fragmentation. Some species adapt to changing conditions better than others (Breshears et al., 2008). In Nigeria, forest tree species are very diverse and contain over 560 species of trees with many of them having commercial importance (Borokini, 2012). The Forestry Research Institute of Nigeria has listed about 85 endangered tree species only in Cross River state, and many of these are endemics; that is, they are found only in this region. Five of them are monospecific, that is, the only representative of a particular genus found in the world (Oguntala et al., 1996). Furthermore, IUCN listed 69 plants located in Nigeria forests as endangered species (IUCN, 2004), an example of which is *Gossweilerodendron balsamiferum*.

Climate change also promotes the spread of forest pests and diseases. In most cases, temperature increment favours the growth of insect populations that are detrimental to forest health (Lucier et al., 2009). In the tropics, increased warming accelerates the life cycle of many insect pests, and increased fire damage makes both plant and animal species more susceptible to disease and insect attacks (FAO 2017). In Nigeria, there has been a tremendous increase in the outbreak of plant pests and diseases, and these could be attributed to global warming and climatic change. In Southwest Nigeria, for instance, various species like mahogany are being attacked by shoot borers such as *Hypsiphyla robusta* and *Phytolyma fusca*, which generally attack iroko (*Millicia excelsa*) (Aluko et al., 2008). The observed susceptibility to new pests and diseases could be attributed to stress induced by climate change which weakens the natural defense of forest species.

In most forest areas, productivity has been found to increase with higher temperatures which is probably due to carbon dioxide fertilization; however in tropical forests, this increase in productivity is temporary and declines when carbon dioxide saturation is reached (FAO 2017). Climate change disturbances may increase and worsen the threats to forest and forest products Akinbile et al., (2018), and this is common

in the tropics where phenological changes may affect ecological processes such as pollination, flowering, and fruit set to a greater extent (FAO 2017). The disruption in the fruiting season will threaten the regeneration ability and productivity of forest plants which will consequently endanger the survival of forest animals that depends on them (Borokini, 2012). In Southern Nigeria, a team of researchers and forest explorers observed that the fruiting potential of *Khaya grandifoliola* plant was disrupted, while the residents in those areas decried a notable change in the weather pattern for several months (Borokini, 2012). This illustration is very common across Nigeria and it shows how climate change distorts the fruiting process of forest trees and the survivability of forest animals that depends on them.

The expected increases in extreme weather events such as heat waves, droughts, floods and the increased risk of fire, pests and diseases will cause additional stress for large forest-dependent populations who often rely directly on forests for their livelihoods and for meeting domestic needs related to energy, food and health (FAO 2017). In Nigeria, over 90% of the rural populace rely on forest products for their livelihood (Federal Government of Nigeria, 1999; UN 2002; IMF 2005; FAO 2008; Onyekuru and Marchant, 2014). Forest provides these households with income, fuel wood, food security, reducing vulnerability to shocks, adversities and generally increasing wellbeing (Arnold, 1998; Fisher and Shively, 2005; Eva and Fred, 2013; Onyekuru and Marchant, 2014). The level of dependence on these products ranges from an average of 14% in the Sudan savannah to 47% in the mangrove with a range of 5–95% (Onyekuru and Marchant, 2014). Hence, the progressive increase in climatic change and its resultant effect on forest products has continued to exacerbate food insecurity and poverty in the rural populace. Osemeobo (2005) found that the average annual value of harvested wild products from the Nigerian forests per household was US\$6,742, while Onyekuru and Marchant (2014) found it to be US\$11,956, indicating a significant increase in the average annual value in less than a decade (Onyekuru and Marchant, 2016).

FROM DESTRUCTION TO PRESERVATION: CLIMATE CHANGE, FORESTRY, AND SUSTAINABILITY

Adaptation and mitigation have been identified by a plethora of authors as a critical approach used in response to climate change. Mitigation is defined by IPCC (2002) as “an anthropogenic intervention to reduce the sources or enhance the sinks of GHGs; while Adaptation is an adjustment in natural or human systems in response to actual or expected climatic stimuli and their impacts on natural and socio-economic systems which moderates harm or exploits beneficial opportunities.” In the forest sector, adaptation includes changes in management practices aimed at reducing forests’ vulnerability to climate change as well as interventions aimed at reducing people’s vulnerability to climate change (FAO 2018). Furthermore, mitigation strategies in the forest sector can be classified into four categories: reducing emissions from deforestation, reducing emissions from forest degradation, increasing forest carbon sequestration and product substitution (FAO 2018). Nigeria seems to be far in terms of managing the effects of climate change on forest biodiversity and this is because the majority of the foresters are not acquainted with requisite forest management skills (Borokini 2012). Regarding GHG emissions reduction, forests absorb CO₂ and release O₂ through photosynthesis with carbon (C) fixed in their biomass and thus sustainable forest management while the use of forest resources without distorting the stability of the ecosystem is essential (Leonel et al., 2019). The various ways by which the impact of climate change on the forest could be mitigated are stated below:

The UNFCCC defines afforestation and reforestation as “direct human-induced conversion of non-forested land to forested land through planting, seeding, and the human-induced promotion of natural seed sources.” Afforestation can occur on land that has not been covered by forest for at least 50 years whereas reforestation can occur on land that was previously forested but has since been subjected to another land use (UNFCCC, 2001). Afforestation has been described as a critical strategy for mitigating the impacts of climate change over a region because it can alter surface properties relevant to climate, generate favourable atmospheric circulations for precipitation, control groundwater and increase evaporation (Abiodun et al., 2012). Forests sequester carbon in their biomass, lowering the concentration of greenhouse gases in the atmosphere that cause global warming. A forest consisting of multiple species is more resilient or less vulnerable due to different climate tolerance of other species, different migration abilities and the effectiveness of invading species (IPCC, 2001). Hence, foresters are advised to prioritize natural regeneration to maintain genetic variability in natural forests and high-density planting with improved regenerative material in both artificial and natural forest (Leonel et al., 2019).

Sustainable forest management is consistent with both adaptation, mitigation and provides a comprehensive framework that can be adapted to changing circumstances (FAO 2018). SFM practices not only contribute to a reduction in CO₂ emissions but also reduce the vulnerability of forests to climate change (Borokini 2012). Forest managers will need to factor climate change into their planning and adjust their management practices accordingly to reduce vulnerability and to facilitate adaptation to climate change (FAO 2018). Forest managers will also need to put greater emphasis on risk management and weigh the costs of changes in forest management against the potential benefits keeping in mind that the prices of climate change adaptation measures are likely to increase the longer they are delayed (FAO 2018). The protection, sustainable management and enhancement of terrestrial and marine ecosystems which act as carbon sinks and reservoirs to greenhouse gases are also vital and this may involve creating buffer zones and encouraging afforestation while reducing deforestation to the barest minimum (Borokini 2012). Furthermore, enhancing soil organic matter content; through organic manuring to increase moisture retention and soil fertility not only reduces the vulnerability to drought and moisture stress but also increases the carbon sequestration rates of trees as well as grass species (Borokini 2012).

Deforestation is a major man-made source of greenhouse. Odjugo and Ikhuria (2003) noted that an average of 320 sticks were used to support the decking of a three-bedroom apartment, plus the plywood's used for the floor of the decking. They also stated that these supporting sticks and plywood's are hardly used twice since they are sold as fuel wood immediately they are removed as support. One could therefore appreciate the number of trees destroyed annually with the current vertical growth of Nigerian cities. The deforestation processes can be reversed if iron, steel and aluminium are used for the construction of our buildings and household furniture (Borokini 2012). Haider 2019 reported that more than 70 percent of the people living in rural areas in Nigeria use fuel wood which has been a pivotal contributor to deforestation. However, reforestation is only about 10 percent of the deforestation rate (Elum and Momodu, 2017) herein lies the urgency to intensify tree planting.

Expansion of protected area and its management could prevent forests from degradation and promote regrowth of trees since the formation of the protected area and its effective management prevents forest degradation and conversion (Borokini 2012). Protected forest areas increase the resilience of ecosystems and landscapes to climate change and can provide a ‘safety net’ for climate change adaptation through their genetic resources and ecosystem services (CPF 2008). Inadequate funding for the management of protected areas however poses a significant threat to climate change mitigation and adaptation (CPF

2008). Hence, Governments are encouraged to redirect sufficient funding to promote sustainable management of protected areas.

Green technology can be defined as sustainable development and technological advancement in a way that reduces greenhouse gas emissions and ensures the conservation of natural resources (Borokini 2012). In Nigeria, as elsewhere in the world, the energy sector is the most important sector for climate change mitigation (Federal Ministry of Environment, 2014). To reduce the emission of greenhouse gases, clean and environmentally friendly technologies are needed. Industrial productions should convert to machines that emit limited or no greenhouse gases. Automobiles and industrial machines should be improved upon to use only ethanol, solar engines, electric engines, or hybrid-electric engines. Gas flaring, especially in the Niger Delta region of Nigeria, should be reduced to the barest minimum (Borokini 2012). It is crucial to control CO₂ emission and other associated greenhouse gases by encouraging the use of renewable energy sources like photovoltaic cells and the development of an efficient energy mechanism (Yahaya and Nwabuogo, 2016). Furthermore, the widespread use of low-cost solar energy cookers instead of wood-burning devices will also limit the current pressure on the Nigerian forest for firewood. Moreover, the use of fuel cells that convert hydrogen fuel directly into electricity without first burning it to produce heat should be encouraged. (Borokini 2012).

Finally, Education and training are vital capacity-building efforts to increase the sustainability and institutionalization of information and knowledge about climate change adaptation. It helps young people understand and address the impact of climate change, encourages changes in their attitudes and behaviour and helps them adapt to climate change-related trends (Amanchukwu et al., 2015). The inclusion of climate change in the Nigerian educational curricula is essential. Basic knowledge about climate change including both the science and its potentials should be taught in an objective and evidence-based way in schools, either as a separate subject or spread between more than one subject area (Amanchukwu et al., 2015). Teacher training and the provision of adequate equipment should be provided to give students the necessary knowledge, skills and understanding that they need to be educated citizens and to manage their own local environments (Amanchukwu et al., 2015). Policymakers should also consider mainstreaming indigenous values and practice into policy guidelines to address climate change issues. This would allow for more comprehensive measures (Nkechi et al., 2016). Institutional capacity building is necessary for all institutional stakeholders engaged in climate change adaptation in Nigeria as this will enable these actors and their personnel to be able to develop and implement policies, programs, projects and other measures to address climate change within the context of good governance (BNRCC, 2011).

Forests play essential roles in the concentration of greenhouse gases in the atmosphere, absorbing 2.6 billion tonnes of carbon dioxide each year, about one-third of the carbon dioxide released by the burning of fossil fuels (CIFOR, undated). The capacity of forests to remove carbon from the atmosphere decreases as they are cut down (FAO 2017). Hence, there is a great need to adopt a collection of forest conservation measures to promote its sustainability. Urgent and appropriate actions need to be taken on climate change in Nigeria by all the stakeholders in order to preserve the rich and diverse forest resources in Nigeria. The development of a national climate-smart agriculture strategy presents an opportunity to promote coordination among stakeholders working in agricultural development, forestry and climate change to articulate a unified vision of agricultural development and sustainable forestry in the face of climate change.

EFFECT'S OF CLIMATE CHANGE ON FISHERIES AND AQUACULTURE PRODUCTION IN NIGERIA

Climate change (CC) is a critical world problem while its impacts has been reported in all ecosystems, societies and economies. Increasing evidence shows that fisheries and aquaculture are particularly affected as aquatic environment is known to be heated up changing the physico-chemical properties of water and hence thus affecting the performance and survival of most fish species which are cold blooded (Oluowo, 2017). As noted by WorldFish Center (2007), West and Central Africa are especially susceptible to the unfavorable effects of CC due to the characteristic nature of their climate, geography and ecology. Several studies (Okoli and Ifeakor, 2014; Anyanwu *et al.*, 2015; Agbola and Fayiga, 2016) have investigated and reported the impacts of CC on food supply and livelihood in Nigeria. However, improving the nutrition and economic status of fishing and aquaculture communities are crucial hence should be included in national adaptation strategies for CC (Kalikoski, 2018).

Although there is an increasing knowledge base on the mitigation of climate change impacts, uncertainties still exist because projections have been based on socio-economic factors (Bahri, 2020). Furthermore, in line with the distinctiveness of ecosystems and their effects on the fisheries sector, it has become necessary to assess the effect of climate change on fisheries and aquaculture production in Nigeria.

Fisheries and Aquaculture Production in Nigeria: Recent Trends and Indicators

The fisheries and aquaculture industry is the most rapidly developing food production sector globally and its' growth is projected to exceed that of human population (Oluwatobi *et al.*, 2017). According to FAO (2020) Asia and in particular, China have dominated global Fish production for the past 2 decades. In Africa and other developing countries, aquaculture and fisheries production are mainly associated with primary productions, low-level artisanal fisheries and aquaculture farmers.

In Nigeria, the total domestic supply of both captures and culture fisheries products for the year 2016 was estimated at 0.7 million metric tonnes per annum with about 0.7 million metric tonnes still imported annually making Nigeria the largest importer of fish products (FAO, 2016; Oluwatobi *et al.*, 2017). Figure 1 shows the trend in aquaculture and inland water fish capture production in Nigeria compared to the continent and global indices as reported by FAO (2020). As presented, total fish production steadily increased in Nigeria from the 1980's till 2017 (making the country the 2nd top aquaculture producer), with a recent drop seen in the year 2018. According to FAO (2020), aquaculture forms the major driver of fish production in the last 3 decades and has grown at the rate of 12% (compared to the global growth rate of 8%) from 1980 to 2016. Capture fisheries on the other hand recently experienced a decline due to excessive fishing pressure, negative impact of Climate change and contamination of the open water resources by oil spillages and effluents from industrial sites (Dauda *et al.*, 2013). These have affected both local and international supply of fish products with a consequent adverse effect on the food supply and economic status of the people and community involved in fishing. Despite the experienced growth in the industry, Nigeria and in particular, Africa's share of the global productions is still low (2.7%), hence necessitating intensified efforts towards increase in productivity.

Table 1. Fisheries statistics of the Federal Republic of Nigeria (real production value; percentage of the global production index)

		Average annual production			Productions			
		1980's	1990's	2000's	2015	2016	2017	2018
		Live weight in million tonnes						
Employment (Thousands)		469.07	490.00	1177.31	1565.36	1565.36	-	-
Capture Fisheries Production								
<i>Inland water.</i>	Nigeria	0.10	0.10	0.21	0.34	0.38	0.42	0.39
	Africa	1.47	1.89	2.34	2.84	2.87	3.00	3.00
	World	5.70	7.05	9.27	11.15	11.37	11.91	12.02
<i>Marine</i>	Nigeria	0.47	0.49	0.46	0.78	0.65	-	-
		1995	2000	2005	2010	2015	-	2018
<i>Aquaculture fish production</i>	Nigeria	16.6 (0.07%)	25.7 (0.08%)	56.4 (0.13%)	200.5 (0.35%)	316.7 (0.44%)	-	291.3 (0.35%)
	Africa	110.2 (0.45%)	399.6 (1.23%)	646.4 (1.46%)	1, 285.8 (2.23%)	1,777.6 (2.44%)	-	2,195.9 (2.67%)
	world	24,382.5	32,417.7	44,298.0	57,743.9	72,771.3	-	82,085.1

Source: FAO (2020)

Climatic Disorder and the Fishing Industry in Nigeria: A Contextual Discourse

Climate change impacts fishery and aquaculture mainly through increase in Carbon (IV) oxide and temperature which heat up water bodies (Oluowo, 2017). It's impact in Nigeria is mainly in the fishery sub-sector due to the alterations in the water abiotic (temperature, and oxygen, salt and acid levels) and biotic (main production and food chain) conditions which affect the growth, size, distribution and catch potentials of aquatic species (Barange *et al.*, 2018). In the area of aquaculture while a continued growth is expected with a possible positive, negative or indistinct impact, lower productivity may be predominantly experienced in developing countries due to poor production conditions and other concerns (Dabbadie *et al.*, 2018).

Direct Impacts of Climate Change

Although it is inappropriate to generalize the impact of CC on fisheries in Nigeria, it however shares in the global effect of CC. Generally, temperature is noted to influence physico-chemical and biological processes in aquatic environment (FAO, 2020). Considering the poikilothermic nature of most fresh water fish, increase in water temperatures beyond optimal ranges may increase their biological energy demand, adversely affecting homeostasis, growth, survival (Ipinjolu *et al.*, 2014). Upwellings along coastal regions can also influence water suitability for fisheries which negatively affects survival, distributions and productivity (Harrod, 2016). Similarly, temperature lowers dissolved oxygen levels, increasing biological oxygen demand (BOD) in aquatic species and stimulating bacteria proliferation

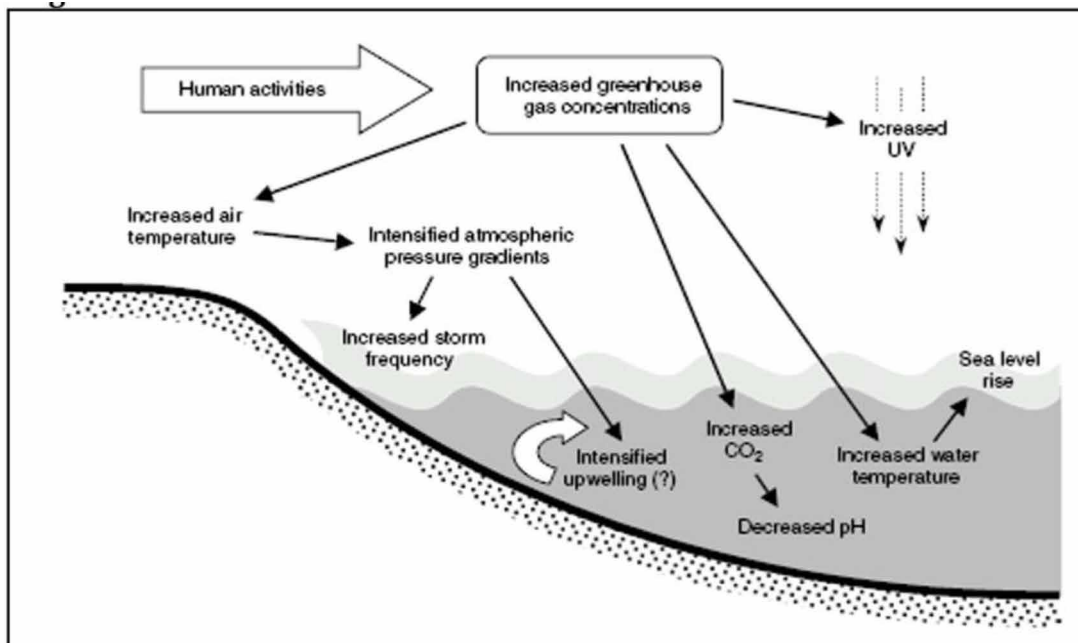
Climate Change and Agricultural Sustainability in Nigeria

(Hall, 2009). Furthermore, temperature may increase bioaccumulation and toxicity of pollutants in fish; while causing earlier and longer stratification in lakes and reservoirs (FAO, 2004). With seasonal warming in Nigeria higher than the global average, the capacity of freshwater fish to support inland fisheries and aquaculture activities was reportedly lowered, especially in Northern regions with prevailing dry and hot conditions (Christensen *et al.*, 2007).

Other impacts of climate change in Nigeria include the recent global rise in sea levels in coastal areas due to thermal expansion and melting of glaciers which affect water salinity, increasing inundation of lower lying areas (Federal Government of Nigeria, FGN, 2014). Also, variations in precipitation patterns causes flooding and droughts in different regions (DFID, 2008). This was evident in the recent flooding events in various regions across the country. Contrastingly, increased precipitation and flooding will result in the inundation of adjacent land onshore areas which benefit fisheries by expanding the littoral zones and increasing the ecotones for fishery activity (Ipinjolu *et al.*, 2013). Figure 1 shows the main effect of CC on the ocean physico-chemical characteristics. As indicated, anthropogenic activities stimulate increased CC incidences through its role in increasing the greenhouse gases.

Figure 2. Major climate change impacts on the ocean characteristics

Source: Harley *et al.* (2006)



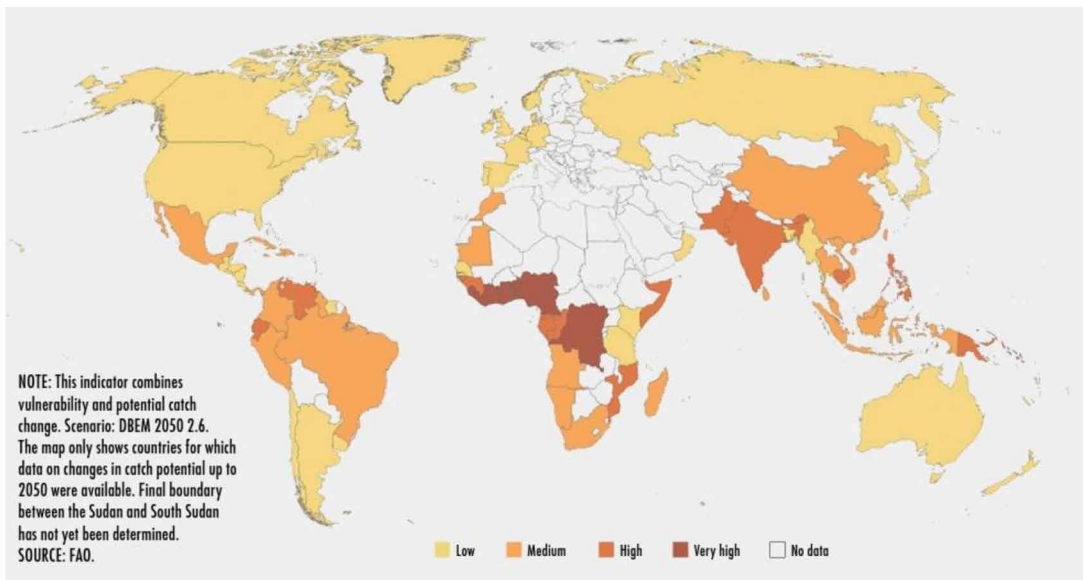
Socio-Economic Impacts

Also, drivers as increase in extreme weather events, and changes in their intensity, frequency and duration, vary across environmental, economic and social factors, and will affect fishery and fishery dependent livelihoods differently (FAO, 2020). Recent report suggests that great part of the country's fishing and

coastal communities now live in precarious and vulnerable situations due to degradation of the aquatic habitats and resources; over-exploitation of the fishery resources; and the socio-economic and poor developmental statuses of these communities (FAO, 2009). Hence, climate change incidences have and is expected to have more reverberating effect in the food supply and livelihoods in the country. Figure 2 presents the vulnerability index of different countries of the world.

Figure 3. Effects of climate change on marine fish production and susceptibility: Country by country hazard index

Source: FAO, 2020



Farmers Consciousness of the Impact of Climate Change on Fisheries and Aquaculture Production: Recounting Nigeria’s Experience

The devastating impacts of climate change (CC) on fisheries and aquaculture have raised concerns about its consequences on food supply and livelihood in Nigeria. Nonetheless, poor awareness and perceptions of farmers about CC scenarios in rural and fishing communities limits their adoption of necessary mitigation strategies (Bankole *et al.*, 2019). Awareness of CC incidences is usually through personal experiences, radios/television, friends and neighbours with extension agents and newspapers playing lesser roles (Aphunu and Nwabeze, 2012).

Available evidences suggest that aquafarmers in Nigeria have wide perceptions about CC impacts on productivity. These perceptions include excessive sunshine; and increased incidences of drought, heavy rainfall and flooding; with minimal or no impact on fish productivity (George, 2010; Bankole *et al.*, 2019). Farmers’ perceptions of significant CC effect on fish production are dependent on factors as farming experiences, number of ponds, membership in associations, educational status, and knowledge

of CC (Agwu and Anyanwu, 1996; Aphunu and Nwabeze, 2012). A case-study of catfish farmers in Oyo State, Nigeria, showed that despite awareness of the importance of CC for production, there were wrong appreciation of the directions and extents of these impacts (Adebayo, 2012). This suggests the need to enlighten and educate farmers on CC impacts, and the need to adopt remediation and management strategies.

Remediation/Mitigation Strategies for Fisheries and Aquaculture Production in Nigeria

According to IPCC (2007), vulnerability to CC impacts is a function of exposures to impacts, sensitivity to CC conditions, and adaptive capacity (AC). For Nigeria with high vulnerability mainly due to low adaptive capacity, effective adaptation efforts must address some or all variables (Daw *et al.*, 2009). Increasing adaptive capacity of farmers reportedly raised productivity by 0.3% in Port Harcourt, Nigeria, suggesting its role in CC adaptation (Okezie and Anurigwo, 2016).

Following low AC of aquafarmers to CC in Nigeria, Mustapha (2013) opined that creating proper awareness, enlightenment, and initiatives for capacity building and resilience; as well as integrating factors like weather forecasting, disaster preparedness, CC-associated conflicts and emergency management, and fisheries development programme into adaptation policies are critical for strengthening the country's resilience and capacity for CC adaptation. For aquaculture, water management, bore-hole constructions, siting farms close to water bodies, erecting embankment for flood prevention, adjusting fish stocking time, raising shades over ponds, using resistant species, are among adaptive strategies employed (Adebayo, 2012; Asiedu, 2016). Whereas, accessing higher value markets or shifting targeted species, reducing production cost, engaging insurance schemes, capacity building, diversifying livelihoods and exiting fishery have been recognized for fisheries (Macfadyen and Allison, 2009; IFAD, 2014).

Conversely, a synergy between "ecosystem" and "co-management" approaches to Fisheries, and developing sophisticated water monitoring programmes and models, represent appropriate mitigation measures for fisheries and fishing community (Mustapha, 2013). While for aquaculture, culturing low-trophic levels species, aquatic plants, integrated multi-trophic Aquaculture, improved energy efficiency and identifying opportunities have been proposed (IFAD, 2014).

Climate Change-Crop Production in Nigeria: An Overview and Linkages

Crop production which accounts for over 80% of total agricultural output in Nigeria is currently facing serious threats (Eregha *et al.*, 2014), and there are projections that towards the end of the 21st century, agricultural production would have been substantially impacted by climate change (Slater *et al.*, 2007), this is largely due to the fact that climate change is a key determinant of crop production in any climate. This informed the position expressed by futurelearn that the fluctuation in climate could endanger the nation's agricultural sector (Futurelearn, 2021), and if this occurs in Nigeria, the resultant consequence would be grave food insecurities and huge toll on human fatalities. This projection calls for intensified researches and the development of remediation strategies to confront this impending challenge of climate change. Also worrisome is a current report from the IPCC stating that in the last 30 years agricultural production declined across the globe (Porter *et al.*, 2014), a major indicator of impending food scarcities with a concomitant negative impact on the globe.

Enunciating Remediation Strategies for the Crop Sub-Sector: What to Do

In order to reduce the impacts of climate change on crop production, there is the need to develop adaptation strategies. Adaptation earlier defined by the Intergovernmental Panel on Climate Change as the adjustments in human and natural systems as a response to expected or actual climatic impacts which helps to reduce the harm or take advantage of embedded opportunities (Intergovernmental Panel on Climate Change (IPCC), 2007), will entail putting measures in place to reduce the negative effects of the climate on crop production or take advantage of its positive impacts (Akinagbe & Irohibe, 2014). Adaptation has proven to be very beneficial across geographical boundaries and should be utilized in stemming the ugly tide of climatic dysfunctionalities.

Several coping strategies have been proposed in a bid to put in check the effects of climate change on the agricultural sub-sector in Nigeria this is largely because the effects of climate change on agricultural production has continued to raise concerns (IATP, 2009). For instance, farmers have been advised to plant crop species that are resistant to drought as some varieties of crops require more volume of water than others. This model has been subjected to experiments in Ghana, Senegal, Nigeria and Burkina Faso (Ngigi, 2009). The practice of crop diversification has also been advised as rather than cultivate a single crop type, farmers could interchange by cultivating other types in a process that would help introduce more resilient varieties (DFID, 2004). Farmers in Nigeria are enjoined to copy this model from Tanzanian farmers who often adopt this system as a risk sharing model (Adger et al., 2003). The longstanding issue of deforestation which has contributed significantly to the challenge of climate change confronting crops production in the agricultural sector can be reversed by embarking on massive afforestation. Aside afforestation, practicing soil conservation measures that conserve soil moisture have proven to be very helpful in tackling the scourge of climate change on crop production. The successes recorded in Burkina Faso and Senegal are templates Nigeria should emulate as while efforts were made to keep the soil together and reverse desertification by the use of fertilizer and traditional pruning techniques in Senegal and Burkina Faso, contour ridges were constructed to reduce soil erosion and enhance moisture conservation in Tanzania (Lema and Majule, 2009).

Mixed cropping has also been recommended as an effective remediation approach aimed at reversing the trend of climate change. This entails growing two crops or more within the same area in order to reap benefits of varying maturity dates, input requirements, drought resistance amongst other advantages. Also considering the importance of water availability for crop production and cultivation, there is the need for water to be made available through irrigation as this would keep the crops alive and enhance productivity in the process reducing the impact of climate change on the sub-sector significantly. There is the need for sufficient measures to be put in place to reduce the negative effects of the climate on crop production or take advantage of its positive impacts (Akinagbe & Irohibe, 2014), this remediation strategies if followed through and properly implemented represents the way to go for the crop sub-sector in Nigeria's agricultural industry.

Climate Change and the Livestock Sub Sector in Nigeria: Issues at Stake

The demand for livestock products is increasing drastically in Nigeria (FAOSTAT, 2019). The Federal Ministry of Agriculture and Rural Development (FMARD) estimated the natural herd in the country to be about 180 million poultry, 184 million cattle, 43.4 million sheep, 76 million goats, 7.5 million pigs, and 1.4 million equines (FMARD, 2017). Conceivably, the implications of climate change will not only

be confined to limited crop food production, but will as well have a considerable effect on livestock production. Banik *et al.* (2015) opined that due to the framework of economies and production systems obtainable in developing countries, the adverse effects of climate change will be devastating. Consequently, as a developing country, Nigeria is predicted to experience with difficulty the demands of climate change (Masseti and Mandelsohn, 2018; Enete and Amusa, 2010; Medugu, 2009). Moreover, as Nigeria seek to meet the growing demands of livestock products as a result of the rise in the population, the number of livestock reared in the country is expected to increase, a scenario which is endangered by climatic change (Ayanlande and Ojebisi 2019).

Livestock production systems is a pool of numerous interacting factors which ensue the conversion of organic and inorganic substances into animal products (Nwosu and Ogbu, 2011). Nevertheless, the various actions and processes involved is affected by human and natural factors (Nwosu and Ogbu, 2011). While the human factors may include population, culture, social structure, choice of animal species, the natural factors are the climate with its numerous distinctive variables: temperature, humidity, rainfall, solar radiation and air flow. These climatic variables in turn influence the quantity, as well as the quality of animal feed resources and in turn, the quality of life and performance of the livestock produced (Nwosu and Ogbu, 2011). The activities of humans over the years instigated climatic changes, thereby influencing natural systems that shape and reshape his immediate environment and that of its habitat (Nwosu and Ogbu, 2011). Gerber *et al.* (2013) reported 14.5% contribution by the livestock sector to the global emissions, thereby contributing to the harmful effects of climate change. Simultaneously, climate change will influence livestock production via the struggle for natural resources, increasing occurrences of livestock diseases, as well as loss of biodiversity (Bellarby *et al.*, 2013).

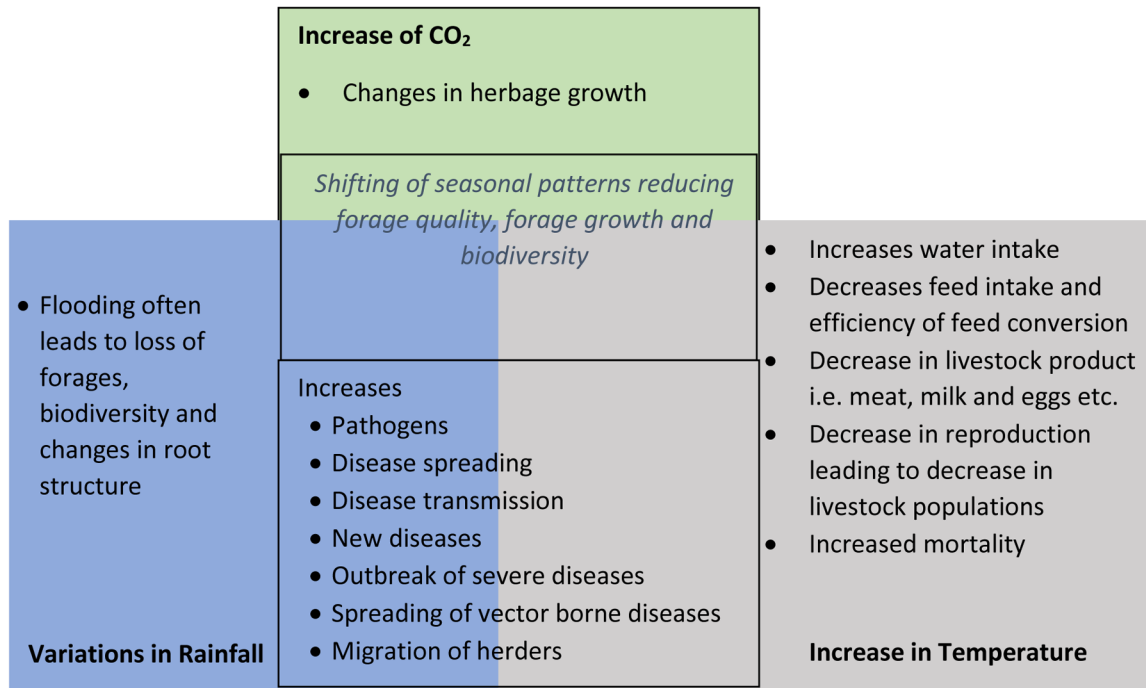
Nigeria's climate configuration reflects the global climate system in its complexities; in terms of weather pattern and sub climate zones traversing from the humid rainforest of the South to the arid/Sahel of the North sandwiched between these two is the derived savanna and savanna ecology. The reports of Ayanlande and Ojebisi (2019) used a 34 years (1984 to 2017) climate data to evaluate the drifts in climate variability and rainfall pattern using the Cumulative Departure Index (CDI). They found out a considerable spatiotemporal differences in both temperature and rainfall with CDI ranging -2.3 to 1.81 and -1.39 to 3.3 respectively. The consequential pressure of these changes directly and indirectly to livestock production will result to a decrease in the quality and quantity of animal feed resources, reduction in available water during dry periods, lower heard sizes, increased heat stress, rising incidence of new diseases and starvation as well as loss of livestock (Liverpool-Tasie *et al.*, 2018; Ayanlade *et al.*, 2017). The Economist, (2019) reported that as food systems in Nigeria transform, the significance of livestock production as a means of livelihood as well as affordable protein is expected to intensify. Hence, it is imperative to understand how climate change influence livestock production, if we are to keep up with this expected intensity.

Climate Dysfunctionalities and its Aftermaths: the Livestock Sub Sector in Perspective

Scientific evidences have shown that changes in climatic variables is a worldwide challenge confronting mankind with developing countries having a greater degree of vulnerability. Rural farmers in Nigeria are highly dependent on rain-fed agriculture, poor and less developed in terms of infrastructure and technological development, therefore are likely to be more vulnerable to climate change (Rojas-Downing *et al.*, 2017). Climate projections indicates that Africa is likely to suffer meaningful changes in climatic

variables, as severe drought will occur in most subtropical regions while the tropics will experience a slight increments in rainfall (Adebisi-Adelani and Oyesola, 2014). As such, competition for land and water, food security at this critical times will adversely influence livestock production (Rojas-Downing *et al.*, 2017).

Figure 4. Interactions of livestock production factors and climate change



The Fifth Assessment Report of the International Panel on Climate Change (2013), recognized that 0.3°C and 4.8°C would be the expected range for the increase in global average surface temperature by 2100. The probable impacts on livestock will include; shifts in production and the quality of feed resources (Rojas-Downing *et al.*, 2017; Thornton *et al.*, 2009), water availability (Nardone *et al.*, 2010; Thornton *et al.*, 2009), milk production, growth performance and diseases (Nardone *et al.*, 2010; Thornton *et al.*, 2009; Rojas-Downing *et al.*, 2017), breeding and reproduction, as well as biodiversity (Rojas-Downing *et al.*, 2017; Nardone *et al.*, 2010). These impacts are primarily due to an increase in temperature and atmospheric carbon dioxide (CO₂) concentration, precipitation variation, and a combination of these factors (IFAD, 2010; Nardone *et al.*, 2010; Thornton *et al.*, 2009; Rojas-Downing *et al.*, 2017). The interactions of livestock production factors and climate change are presented in Fig. 1. It shows that temperature is critical and interacts mostly with other livestock production factors for livestock production, such as water availability, animal production, reproduction and health. The rise in temperature as well as precipitation variations mainly affect livestock diseases. On the other hand, forage quality and quantity are influenced by a combination of the rise in temperature, CO₂ and precipitation variation.

Effect on Quality and Quantity of Feeds and Available Water

The rises in temperature as well as continued dry conditions will affect the quality of forages and feed crops due to fluctuations in the concentrations of water-soluble carbohydrates and nitrogen. Plant components like cell wall and lignin may be negatively affected by temperature increases (Rojas-Downing *et al.*, 2017), thereby reducing the rate of degradation and digestibility (IFAD, 2010; Rojas-Downing *et al.*, 2017), resulting to a decrease in nutrient availability for livestock (Rojas-Downing *et al.*, 2017). A research by Ayanlande and Ojebisi (2019) confirmed the decrease in the amount of water available for cattle production in Nigeria. Their survey showed that drought was the major extreme weather event affecting livestock productivities as recognized by 97.5% of the farmers interviewed.

Effect on Livestock Diseases and Health

The impacts of climate change on livestock diseases and health will be determined by the disease characteristics, land use type, geographical region, as well as the susceptibility of animals (Thornton *et al.*, 2009). Climate change, notable rising temperatures will directly or indirectly affect animal health (Nardone *et al.*, 2010). The potential increase in morbidity and death of animals are direct effects related to the increase of temperature. Whereas, the indirect effects are associated with the effects of climate change on microbial communities (pathogens or parasites), spreading of vector-borne diseases, food-borne diseases, host resistance, feed and water scarcity (Rojas-Downing *et al.*, 2017). The increase in temperature could speed up the progression of pathogens and/or parasites that live part of their life cycle outside of their host, thereby negatively affecting livestock (Rojas-Downing *et al.*, 2017).

Effect on Production and Reproduction

In Nigeria, significant economic losses have been reported in animal production as a result of heat stress (Ayanlade *et al.*, 2017). The high weights, thick coats and dark colours of beef cattle makes them more vulnerable to increased temperatures (Nardone *et al.*, 2010). Climate change has resulted further to a decrease in body size, carcass weight, and fat thickness of ruminant animals (Rojas-Downing *et al.*, 2017).

Effect on Biodiversity

Biodiversity denotes the range of genes, organisms, and ecosystems present in a particular environment and contributes to welfare of humans (Rojas-Downing *et al.*, 2017). Biodiversity loss is a result of the direct impact of climate change and this poses a great risk to populations that are experiencing reduction in genetic biodiversity (UNEP, 2012). Thomas *et al.* (2004) opined that about 15% to 37% of all species in the world may be destroyed by climate change as rising temperatures affects reproduction, migration, mortality, and distribution of species (Rojas-Downing *et al.*, 2017). Plant and animal biodiversity may experience a loss of about 20 to 30% according to the report of the Fifth Assessment of Intergovernmental Panel on Climate Change if there is an increase of 2 to 3°C above pre-industrial levels (IPCC, 2014). Sadly, about 16% of livestock breeds (ass, water buffalo, cattle, goat, pig, sheep, and horse) were lost by the year 2000 (Thornton *et al.*, 2009). Furthermore, from about 7,616 livestock breeds reported by the FAO (2007), 20% were at risk, and for every month, almost one breed is eliminated.

Strategies to Combat the Effects of Climate Change on Livestock

Adopting modifications in the system of management will involve integration of livestock systems with crop production and forestry, diversification of livestock animals/crops while changing the timing and locations of farm operations (IFAD, 2010). In addition, diversification of crops and livestock animals can be valuable in combating climate change-related diseases and pest outbreaks (Rojas-Downing *et al.*, 2017). A mixed land management approach of planting trees alongside crops and pastures can help maintain the balance between agricultural production, environmental protection and carbon sequestration to offset emissions from the livestock sector. This may help improve productivity and quality of air, soil, water, biodiversity, pests and diseases, as well as improved nutrient cycling (Rojas-Downing *et al.*, 2017).

Enhancing feeding practices as an adaptive strategy could indirectly improve livestock production efficiency (Rojas-Downing *et al.*, 2017). These may include, training the producers of feed in the production and conservation of feed for different agro-ecological zones (IFAD, 2010), incorporating agroforestry species in the animal diet (Rojas-Downing *et al.*, 2017), thereby changing the diets composition, and making changes in the frequency and/or time of feeding (Renaudeau *et al.*, 2012). These enhanced practices can help ameliorate the challenges posed by climate change in livestock production through the increase of feed intake or compensating low feed consumption, reducing excessive heat load (Renaudeau *et al.*, 2012), reducing animal malnutrition and mortality (IFAD, 2010) and decreasing the feed insecurity during dry seasons (Rojas-Downing *et al.*, 2017)

Adaptation to local environments is necessary, if livestock can cope with climate change. Therefore modifications in breeding strategies to give rise to animals that can cope and/or tolerate heat stress and emerging diseases can help improve reproduction and growth (Rojas-Downing *et al.*, 2017). Therefore, the challenge is in identifying characters that could be harnessed to improve livestock production, at the same time maintaining the valuable adaptations features to the local environment, which in all requires additional research (Thornton *et al.*, 2008). Also, facilitating the implementation of these breeding strategies through the right policy will be crucial (USDA, 2013). For instance, developing gene banks in Nigeria for the different regions could go a long way to improve breeding programs and serve as an insurance policy for genetic diversity in the local environment, such as has been done for plants with the In-Trust plant collections in the CGIAR gene banks (Thornton *et al.*, 2008).

The disposition and capabilities of farmers to recognize climatic change and adaptation is one of the challenges in adopting any available mitigation strategy (Liverpool-Tasie *et al.*, 2018). Therefore, it is imperative to assess farmer's perceptions to climate change and any litigation and adaptive measure. Qualitative approaches; like open-ended survey questions and/or group discussions at workshops to sample individual and group opinions from different localities has enabled researchers in climate change adaption, to obtain information about farmers' perceptions (Liverpool-Tasie *et al.*, 2018; Barnes, 2013). There would be a higher chance of achieving food security and environmental conservation objectives if farmers' perceptions about climate change adaption is understood, and hitherto including them in rural policy development (Barnes, 2013). Furthermore, Woods *et al.* (2017) and Zamasiya *et al.* (2017) opined that farmers' perception about climate change and their experiences of loss due to climate factors are also likely to affect their adoption of adaptation strategies.

CONCLUSION

Overall, the intent of this chapter was to holistically examine the impacts of climate change on four agricultural sub-sectors viz; crops, fisheries, livestock and forestry and offer remediative strategies. These sectors apart from the quantum of contribution they make to the nation's food bank play a very significant role in the agricultural value chain. Having carried out a critical assessment on each of them from the prism of extant and relevant literature, we state without any iota of doubt that they face severe threats induced by climate change which could produce more detrimental outcomes if not urgently arrested. It has also been discovered that proper agricultural techniques can help in checkmating the scourge of climatic dysfunctionalities. Taking into cognizance the huge population of the Nigerian state and the untoward consequences food insecurity could trigger, we make bold to state that the time to check the impacts of climate change on the above listed sub-sectors is now.

REFERENCES

- Abiodun, B. J., Salami, A. T., Matthew, O. J., & Odedokun, S. (2013). Potential impacts of afforestation on climate change and extreme events in Nigeria. *Climate Dynamics*, *41*(2), 277–293. doi:10.100700382-012-1523-9
- Adebayo, O. O. (2012). Climate Change Perception and Adaptation Strategies on Catfish Farming in Oyo State, Nigeria. *Global Journal of Science and Frontier Researcher and Agricultural Veterinary Science*, *12*(6), 24–28.
- Adebisi-Adelani, O., & Oyesola, O. (2014). Farmers' perceptions of the effect of climate change on tomato production in Nigeria. *International Journal of Vegetable Science*, *20*(4), 366–373. doi:10.1080/19315260.2013.813890
- Adger, W. N., Huq, S., Brown, K., Conway, D., & Hulme, M. (2003). Adaptation to climate change in the developing world. *Progress in Development Studies*, *3*(3), 179–195. doi:10.1191/1464993403ps060oa
- Agbola, P., & Fayiga, A. O. (2016). Effects of Climate Change on Agricultural Production and Rural Livelihoods in Nigeria. *Journal of Agricultural Research and Development*, *15*(1).
- Agbola, P., & Fayiga, A. O. (2016). Effects of climate change on agricultural production and rural livelihood in Nigeria. *Journal of Agricultural Research and Development*, *15*(1).
- Agwu, E. A., & Anyanwu, A. C. (1996). Socio-cultural and environmental constraints in implementing the NALDA programme in south eastern Nigeria. A case study of Abia and Enugu State. *Journal of Agricultural Education*, *2*, 68–72.
- Akinbile, L. A., Aminu, O. O., & Kolade, R. I. (2018). Perceived Effect of Climate Change on Forest Dependent Livelihoods in Oyo State, Nigeria. *Journal of Agricultural Extension*, *22*(2), 169–179. doi:10.4314/jae.v22i2.15
- Akinngbe, O.M., & Irohibe, I.J. (2014). Agricultural Adaptation strategies to climate change impacts in Africa: A Review. *Bangladesh J. Agril Res*, *39*(3), 407-418.

- Aluko, A. P., Adebago, C. A., & Ukpe, I. E. (2008). Implications of climate change on sustainable forest management in Nigeria. *Journal of Sustainable Environment Management*, (I), 53–58.
- Amanchukwu, R. N. (2015). Climate change education in Nigeria: The role of curriculum review. *Education*, 5(3), 71–79.
- Anyanwu, C. N., Amadi-Eke, A. S. Nwaka, D. E., Ezeafulukwe, C. F., & Adaka, G. S. (2015). Climate change effects and mitigation strategies on aquaculture: A review. *Agriculture, Forestry and Fisheries*, 4(3-1), 70-72.
- Aphunu, A., & Nwabeze, G. O. (2012). Fish farmers' perception of climate change impact on fish production in Delta State Nigeria. *Journal of Agricultural Extension*, 16(2).
- Asiedu, B. (2016). Aquaculture in troubled climate: Farmers' perception of climate and their adaptation strategies in Ghana, West Africa. *Journal of Aquaculture Research & Development*, 7(11).
- Ayanlade, A., & Ojebisi, S. M. (2019). Climate change impacts on cattle production: Analysis of cattle herders' climate variability/change adaptation strategies in Nigeria. *Change and Adaptation in Socio-Ecological Systems*, 5(1), 12–23. doi:10.1515/cass-2019-0002
- Ayanlade, A., Radeny, M., & Morton, J. F. (2017). Comparing smallholder farmers' perception of climate change with meteorological data: A case study from southwestern Nigeria. *Weather and Climate Extremes*, 15, 24–33. doi:10.1016/j.wace.2016.12.001
- Bahri, M. (2020). System Archetypes to understand the impacts of climate change on rice production: A case Study in West Nusa Tenggara, Indonesia. Preprints, 2020040499
- Banik, S., Pankaj, P., Naskar, S., Malik, P., Bhatta, R., Takahashi, J., Kohn, R., & Prasad, C. (2015). Climate change: Impacts on livestock diversity in tropical countries. *Livestock Production and Climate Change*, 6, 162–182. doi:10.1079/9781780644325.0162
- Bankole, A. F., Ayanboye, A. O., Adeosun, O., Osuntade, O. B., & Adelodun, O. B. (2019). Perceived implication of climate change on fish farming ibarapa region of Oyo State. *Nigeria. Asian Journal of Agricultural Extension. Economia e Sociologia*, 31(1), 1–6.
- Barange, M., Bahri, T., Beveridge, M. C. M., Cochrane, K. L., Funge-Smith, S., & Poulain, F. (Eds.). (2018). *Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options*. FAO Fisheries and Aquaculture Technical Paper No. 627. FAO. www.fao.org/3/i9705en/i9705en.pdf
- Bellarby, J., Tirado, R., Leip, A., Weiss, F., Lesschen, J. P., & Smith, P. (2013). Livestock greenhouse gas emissions and mitigation potential in Europe. *Global Change Biology*, 19(1), 3–18. doi:10.1111/j.1365-2486.2012.02786.x PMID:23504717
- BNRCC (Building Nigeria's Response to Climate Change). (2011). *National adaptation strategy and plan of action on climate change for Nigeria (NASPA-CCN)*. Prepared for the Federal Ministry of Environment Special Climate Change Unit.

Climate Change and Agricultural Sustainability in Nigeria

- Borokini, T. I., Babalola, F. D., Amusa, T. O., Ivande, S. T., Wala, Z. J., Jegede, O. O., Tanko, D., & Ihuma, J. O. (2012). Community Based Forest Resources Management in Nigeria: Case Study of of Ngel Nyaki Forest Reserve, Mambilla Plateau, Taraba State, Nigeria. *Journal of Tropical Forestry and Environment*, 2(1), 69–76. doi:10.31357/jtfe.v2i1.571
- Brack, D. (2019). Forests and Climate Change. *The fourteenth session of the United Nations Forum on Forests*.
- Breshears, D. D., Huxman, T. E., Adams, H. D., Zou, C. B., & Davison, J. E. (2008). Vegetation synchronously leans upslope as climate warms. *Proceedings of the National Academy of Sciences of the United States of America*, 105(33), 11591–11592. doi:10.1073/pnas.0806579105 PMID:18697950
- Ceballos, A., Dresdner-Cid, J. D., & Quiroga-Suazo, M. (2018). Does the location of salmon farms contribute to the reduction of poverty in remote coastal areas? An impact assessment using a Chilean case study. *Food Policy*, 75, 68–79. doi:10.1016/j.foodpol.2018.01.009
- Chijioke, O. B., Haile, M., & Waschkeit, C. (2011). *Implication of climate change on crop yield and food accessibility in Sub-Saharan Africa, Interdisciplinary Term Paper ZEF Doctoral Studies Program*. Center for Development Research, University of Bonn.
- Christensen, J. H., Hewitson, B., Busuioc, A., Chen, A., Gao, X., Held, I., Jones, R., Kolli, R. K., Kwon, W. T., Laprise, R., Magaña Rueda, V., Mearns, L., Menéndez, C. G., Räisänen, J., Rinke, A., Sarr, A., & Whetton, P. (2007). Regional climate projections. In S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor, & H. L. Miller (Eds.), *Climate change 2007: The physical science basis. contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press.
- CIFOR. (n.d.). *Forests and climate change*. www.cifor.org/forests-and-climate-change
- Clean. (2021). *Human activities are impacting the climate system*. <https://cleanet.org>
- Climefish. (2020). *Climate Change and Impacts on Aquaculture*. <https://climefish.eu>
- Council on Foreign Relations. (2009). *Deforestation and Greenhouse Gas Emissions*. <https://www.cfr.org>
- CPF. (2008). *Strategic framework for forests and climate change. A proposal by the CPF for a coordinated forest-sector response to climate change*. Collaborative Partnership on Forests.
- Dabbadie, L., Aguilar-Manjarrez, J., Beveridge, M. C. M., Bueno, P. B., Ross, L. G., & Soto, D. (2018). Effects of climate change on aquaculture: drivers, impacts and policies. In M. Barange, T. Bahri, M. Beveridge, K. Cochrane, S. Funge-Smith, & F. Poulain (Eds.), *Impacts of Climate Change on Fisheries and Aquaculture: Synthesis of Current Knowledge, Adaptation and Mitigation Options*. FAO Fisheries Technical Paper 627. www.fao.org/3/i9705en/i9705en.pdf
- Dauda, A. B., Folorunso, L. A., & Dasuki, A. (2013). Use of Probiotics for Sustainable Aquaculture Production in Nigeria. *Journal of Agriculture and Social Research*, 13, 35–45.

Daw, T., Adger, W. N., Brown, K., & Badjeck, M. C. (2009). Climate change and capture fisheries: potential impacts, adaptation and mitigation. In K. Cochrane, C. De Young, D. Soto, & T. Bahri (Eds.), *Climate change implications for fisheries and aquaculture: overview of current scientific knowledge. FAO Fisheries and Aquaculture Technical Paper no. 530* (pp. 107–150). Food and Agriculture Organization of the United Nations, FAO.

De Rensis, F., & Scaramuzzi, R. J. (2003). Heat stress and seasonal effects on reproduction in the dairy cow: A review. *Theriogenology*, *60*(6), 1139–1151. doi:10.1016/S0093-691X(03)00126-2 PMID:12935853

Debay, T. (2010). *The impact of climate change in Africa*. ISS Paper 220.

Department for International Development. (2008). Impact of climate change on Nigeria's economy. DFID.

DFID. (2004). *Adaptation to climate change: the right information can help the poor to cope*. Global and Local Environment Team, Policy Division.

Dimelu, M. U. (2014). Challenges In building climate change mitigation and adaptation capacity of extension professionals in Nigeria. *PAT*, *10*(1), 110-122. <https://pdfs.semanticscholar.org/82c2/4dfe13159cd47be90c418d2c67b087f69991.pdf>

Ecological impacts of Climate Change. (2008). *Committee on Ecological Impacts of Climate Change*. United States Geological Survey.

Elum, Z. A., & Momodu, A. S. (2017). Climate change mitigation and renewable energy for sustainable development in Nigeria: A discourse approach. *Renewable and Sustainable Energy Reviews, Elsevier*, *76*(C), 72–80. doi:10.1016/j.rser.2017.03.040

Enete, A. A., & Amusa, A. T. (2010). Challenges of Agriculture Adaptation to climate change in Nigeria: a synthesis from the literature. *The Journal of Field Actions Science Reports*, *2*, 1-22.

Eregha, P. B., Babatolu, J. S., & Akinnubi, R. T. (2014). Climate change and crop production in Nigeria: An Error Correction Modeling Approach. *International Journal of Energy Economics and Policy*, *4*(2), 297–311.

FAO. (2007). *Climate change and food security*. FAO.

FAO. (2008). Strategic framework for forests and climate change. A proposal by the Collaborative Partnership on Forests for a coordinated forest-sector response to climate change. FAO.

FAO. (2019). The future of livestock in Nigeria. Opportunities and challenges in the face of uncertainty. FAO.

FAO. (2020). *Livestock Production and Climate Change*. Climate Smart Agriculture Sourcebook. Accessed from www.fao.org

FAO. (2017). *B3 Climate-smart forestry*. Retrieved 18th February 2021 from <http://www.fao.org/climate-smart-agriculture-sourcebook/production-resources/module-b3-forestry/b3-overview/en/?type=111>

FAO. (2018). *Climate Change Adaptation and Mitigation*. Retrieved 18th February 2021 from <http://www.fao.org/sustainable-forest-management/toolbox/modules/climate-change-adaptation-and-mitigation/tools/en/?type=111>

Climate Change and Agricultural Sustainability in Nigeria

FAOSTAT. (2019). Available at: <http://www.fao.org/faostat/en/#data/TP>

Federal Ministry of Environment. (2014). *United Nations Climate Change Nigeria. National Communication (NC)*. NC 2. 2014. <https://unfccc.int/sites/default/files/resource/nganc2.pdf>

Federal Ministry of Environment. (2014). *Nigeria's second National Communication under the United Nations Framework Convention on Climate Change*. Abuja: Federal Ministry of Environment.

FMARD. (2017). *Animal population data*. Federal Ministry of Agriculture and Rural Development.

Folnovic, T. (2020). *Climate Change impacts on Agriculture*. Accessed from <https://www.agrivi.com>

Food and Agriculture Organization (FAO). (2004). *FAO recommendations on the prevention, control and eradication of highly pathogenic avian influenza (HPAI) in Asia*. FAO Position Paper. FAO.

Food and Agriculture Organization (FAO). (2009). *The state of world fisheries and Aquaculture-2008 (SOFIA)*. FAO Fisheries and Aquaculture Department.

Food and Agriculture Organization (FAO). (2016). *State of World Fisheries and Aquaculture-Contributing to food security and nutrition for all*. Fisheries and Aquaculture Department, Food and Agriculture Organization of the United Nations.

Food and Agriculture Organization (FAO). (2020). *The State of World Fisheries and Aquaculture 2020. Sustainability in action*. doi:10.4060/ca9229en

Futurelearn. (2021). *Impact of agriculture on climate change*. Accessed from <https://www.futurelearn.com>

Futurelearn. (2021). *Impact of climate change on agriculture*. Accessed from <https://www.futurelearn.com>

George, F. O. A. (2010). Indigenous and emerging technologies for climate change adaptation in aquaculture and fisheries. *Journal of Sustainable Development*, 7(2), 34–42.

Gerber, P. J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Falcucci, A., & Tempio, G. (2013). *Tackling Climate Change Through Livestock: A Global Assessment of Emissions and Mitigation Opportunities*. FAO.

Global Forest Watch. (n.d.). *Tree Cover Loss*. www.globalforestwatch.org

Haider, H. (2019). *Climate change in Nigeria: Impacts and responses. K4D Helpdesk Report 675*. Institute of Development Studies.

Halls, A. S. (2009). Addressing fisheries in the climate change and adaptation initiative. *Fisheries Research and Development. Melkong Region*, 15.

Hamed, A. (2021). Climate Change contributes to water scarcity, chapter 3, in *Adaptation to a changing climate in the Arab countries, A case for adaptation*. In *Governance and Leadership in Building Climate Resilience*. The World Bank.

Harley, C. D. G., Randall Hughes, A., Hultgren, K. M., Miner, B. G., Sorte, C. J. B., Thornber, C. S., Rodriguez, L. F., Tomanek, L., & Williams, S. L. (2006). The impacts of climate change in coastal marine systems. *Ecology Letters*, 9(2), 228–241. doi:10.1111/j.1461-0248.2005.00871.x PMID:16958887

Harley, C. D. G., Randall Hughes, A., Hultgren, K. M., Miner, B. G., Sorte, C. J. B., Thornber, C. S., Rodriguez, L. F., Tomanek, L., & Williams, S. L. (2006). The impacts of climate change in coastal marine systems. *Ecology Letters*, 9(2), 228–241. doi:10.1111/j.1461-0248.2005.00871.x PMID:16958887

Harrod, C. (2016). Climate change and freshwater fisheries. In J. F. Craig (Ed.), *Freshwater fisheries ecology* (pp. 641–694). John Wiley & Sons, Ltd., doi:10.1002/9781118394380.ch50

Herrero, M., Thornton, P. K., Notenbaert, A., Msangi, S., Wood, S., Kruska, R., Dixon, J., Bossio, D., van de Steeg, J., Ade Freeman, H., & Li, X. (2012). Drivers of Change in Crop–Livestock Systems and Their Potential Impacts on Agro-Ecosystems Services and Human Wellbeing to 2030: A Study Commissioned by the CGIAR Systemwide Livestock Programme. International Livestock Research Institute, Nairobi, Kenya.

Herrero, M., Thornton, P. K., Notenbaert, A. M., Wood, S., Msangi, S., Freeman, H. A., Bossio, D., Dixon, J., Peters, M., van de Steeg, J., Lynam, J., Rao, P. P., Macmillan, S., Gerard, B., McDermott, J., Sere, C., & Rosegrant, M. (2010). Smart investments in sustainable food production: Revisiting mixed crop livestock systems. *Science*, 327(5967), 822–825. doi:10.1126/science.1183725 PMID:20150490

Hoogeveen. (2020). Forests and Climate Change: from complex problem to integrated solution. *UN Chronicle*. Accessed from <https://www.un.org>

IATP. (2009). *Agriculture and climate-the critical connection*. Institute for Agriculture and Trade Policy.

IFAD (International Fund for Agricultural Development). (2010). *Livestock and climate change*. <https://www.ifad.org/lrkm/events/cops/papers/climate.pdf>

Intergovernmental Panel on Climate Change (IPCC). (2001). *Summary for Policymakers*. IPCC.

Intergovernmental Panel on Climate Change (IPCC). (2002). *Climate Change and Biodiversity*. IPCC Technical Paper V.

Intergovernmental Panel on Climate Change (IPCC). (2007). *Impact, Adaptation and Vulnerability. Contribution of Working Group I of the Intergovernmental Panel on Climate Change (Third Assessment Report)*. Cambridge University Press.

Intergovernmental Panel on Climate Change (IPCC). (2007). *Impact, Adaptation and Vulnerability. Contribution of Working Group I of the Intergovernmental Panel on Climate Change (Third Assessment Report)*. Cambridge University Press.

International Fund for Agricultural Development (IFAD). (2014). Impact of climate change on fisheries and aquaculture in the developing world and opportunities for adaptation, fisheries thematic paper: Tool for project design. Rome: IFAD.

IPCC. (2013). *The Physical Science Basis: Working Group I. Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press.

IPCC. (2014). *Climate Change 2014–Impacts, Adaptation and Vulnerability: Regional Aspects*. Cambridge University Press.

Climate Change and Agricultural Sustainability in Nigeria

Ipinjolu, J. K., Magawata, I., & Shinkafi, B. A. (2013). Potential impact of climate change on fisheries and aquaculture in Nigeria. *Proceedings of 28th FISON annual conference*.

Ipinjolu, J. K., Magawata, I., & Shinkafi, B. A. (2014). Potential impact of climate change on fisheries and aquaculture in Nigeria. *Su Ürünleri Dergisi*, 9(5), 338–344.

IUCN. (2004). 2004 IUCN Red List Categories and Criteria. IUCN.

Kalikoski, D. C., Jentoft, S., Charles, A., Salazar Herrera, D., Cook, K., Béné, C., & Allison, E. H. (2018). Understanding the impacts of climate change for fisheries and aquaculture: applying a poverty lens. In *Impacts of climate change on fisheries and aquaculture: Synthesis of current knowledge, adaptation and mitigation options*. Documento técnico de pesca y acuicultura de la FAO no 627. Roma: FAO.

Kim, C. (2009). *Impacts and counter-measures of climate change in Korean agriculture*. Korean Research Report No 593. Korea Rural Economic Institute.

Kurukulasuriya, P., Mendelsohn, R., Hassan, J., Benhin, T., Deressa, M., Diop, H. M., Eid, H. M., Fosu, K. Y., Gbetibouo, G., Jain, S., Mahamadou, A., Mano, R., Kabubo-Mariara, J., El-Marsafawy, S., Molua, E., Ouda, S., Ouedraogo, M., Séne, I., Maddison, D., ... Dinar, A. (2006). Will African agriculture survive climate change. *The World Bank Economic Review*, 20(3), 367–388. doi:10.1093/wber/lhl004

Lamboll, R., & Nelson, V. (2012). *Exploring the linkages and guiding concepts relevant to climate change*. Agriculture and Development working paper No 2

Lema, M. A., & Majule, A. E. (2009). Impacts of climate change, variability and adaptation strategies on agriculture in semi-arid areas of Tanzania; The case of Manyoni District in Singida Region, Tanzania. *African Journal of Environmental Science and Technology*, 3(8), 206–218. doi:10.5897/AJEST09.099

Leonel, J. R. N., Catarina, I. R. M., Carlos, J. P. G., & Nuno, M. C. A. (2019). Forest Management and Climate Change Mitigation: A Review on Carbon Cycle Flow Models for the Sustainability of Resources. *Sustainability*, 11(19), 5276. doi:10.3390/u11195276

Liverpool-Tasie, L. S. O., Sanou, A., & Tambo, J. T. (2018). Climate change adaptation among poultry farmers: Evidence from Nigeria. *Climatic Change*, 157(3-4), 527–544. doi:10.1007/10584-019-02574-8

Lucier, A., Ayres, M., Karnosky, D., Thompson, I., Loehle, C., Percy, K., & Sohngen, B. 2009. Forest responses and vulnerabilities to recent climate change. In *Adaptation of forests and people to climate change*. IUFRO World Series 22.

Ludwig, F. (2007). *Climate Change Impacts on Developing Countries-EU Accountability*. Policy Department Economic and Scientific Policy, European Parliament.

Macfadyen, G., & Allison, E. (2009). *Climate change, fisheries, trade and competitiveness: understanding impacts and formulating responses for Commonwealth small states*. Commonwealth Secretariat.

Masseti, E., & Mendelsohn, R. (2018). Measuring climate adaptation: Methods and evidence. *Review of Environmental Economics and Policy*, 12(2), 324–341. doi:10.1093/reep/rey007

Medugu, N. I. (2009). *Nigeria: Climate Change – A Threat to the Country's Development*. <https://www.allafrica.com/nigeria/>

- Mendelsohn, R., Dinar, A., & Williams, L. (2006). The distributional impact of climate change on rich and poor countries. *Environment and Development Economics*, 11(2), 159-178.
- Mustapha, M. K. (2013). Potential Impacts of Climate Change on Artisanal Fisheries of Nigeria. *Journal of Earth Science & Climatic Change*, 4(130). Advance online publication. doi:10.4172/2157-7617.1000130
- Nardone, A., Ronchi, B., Lacetera, N., Ranieri, M. S., & Bernabucci, U. (2010). Effects of climate change on animal production and sustainability of livestock systems. *Livestock Science*, 130(1-3), 57–69. doi:10.1016/j.livsci.2010.02.011
- NASA. (2021). *The Effects of Climate Change, Global Climate Change, Vital Signs of the Planet*. Accessed from <https://www.climate.nasa.gov>
- Ngigi, S. N. (2009). *Climate change and adaptation strategies: water resources management option s for small holder farming systems in Sub-Saharan Africa*. The MDG Centre for East and Southern Africa, The Earth Institute, Columbia University.
- Nkechi, O. (2016). Mitigating climate change in Nigeria: African traditional religious values in focus. *Mediterranean Journal of Social Sciences*, 7(6), 299–308. <https://www.mcser.org/journal/index.php/mjss/article/view/9612>
- Nwosu, C. C., & Ogbu, C. C. (2011). Climate change and livestock production in nigeria: Issues and concerns. *Agro-Science J Trop Agri, Food. Environ Extension*, 10, 41–60.
- Odjugo, A. O. P., & Isi, A. I. (2003). The impact of climate change and anthropogenic factors on desertification in the semi-arid region of Nigeria. *Global Journal of Environmental Sciences*, 2(2), 118–127. doi:10.4314/gjes.v2i2.2418
- Oguntala, A. B., Soladoye, M. O., Ugbogu, O. A., & Fashola, A. T. (1996). A review of endangered tree species of Cross River State and Environs. Academic Press.
- Okezie, C. R., & Anurigwo, E. C. (2016). Fish Farmers Adaptive Capacities to Climate Change, in Port Harcourt Riverine Areas of Rivers State, Nigeria. *International Journal of Agriculture and Earth Science*, 2(4), 66–73.
- Okoli, J. N., & Ifeakor, A. C. (2014). An overview of climate change and food security: Adaptation strategies and mitigation measures in Nigeria. *Journal of Education and Practice*, 5(32).
- Olaniyi, O. A., Olutimehin, I. O., & Funmilayo, O. A. (2019). Review of Climate Change and Its effect on Nigeria Ecosystem. *International Journal of Rural Development. Environment and Health Research.*, 3(3), 92–100. doi:10.22161/ijreh.3.3.3
- Oluowo, E. F. (2017). Impact of climate change on aquaculture and fisheries in Nigeria: A review. *International Journal of Multidisciplinary Research and Development*, 4(1), 53–59.
- Oluwatobi, A. A., Mutalib, H. A., Adeniyi, T. K., Olabode, J. O., & Adeyemi, A. (2017). *Possible aquaculture development in Nigeria: evidence for commercial prospects*. Academic Press.
- Onyekuru, A. N., & Marchant, R. (2014). *Climate change impact and adaptation pathways for forest dependent livelihood systems in Nigeria*. doi:10.5897/AJAR2013.8315

Climate Change and Agricultural Sustainability in Nigeria

Onyekuru, N. A., & Marchant, R. (2016). Agricultural and Forest Meteorology Assessing the economic impact of climate change on forest resource use in Nigeria: A Ricardian approach. *Agricultural and Forest Meteorology. Elsevier B.*, 220, 10–20. doi:10.1016/j.agrformet.2016.01.001

Osemeobo, G. J. (2005). Living on Wild Plants: Evaluation of the Rural Household Economy in Nigeria. *Environmental Practice*, 7(04), 246–256. doi:10.1017/S1466046605050386

Porter, J. R., Xie, L., Challinor, A. J., Cochrane, K., Howden, M., Iqbal, M. M., Lobell, D. B., & Travasso, M. I. (2014). Food security and food production systems, climate change 2014, Impacts, Adaptation and Vulnerability. Working Group 11 contribution to the IPCC 5th Assessment Report, Geneva, Switzerland

Renaudeau, D., Collin, A., Yahav, S., De Basilio, V., Gourdine, J. L., & Collier, R. J. (2012). Adaptation to hot climate and strategies to alleviate heat stress in livestock production. *Animal*, 6(05), 707–728. doi:10.1017/S1751731111002448 PMID:22558920

Rojas-Downing, M. M., Nejadhashemi, A. P., Harrigan, T., & Woznicki, S. A. (2017). Climate change and livestock: Impacts, adaptation, and mitigation. *Climate Risk Management*, 16, 145–163. doi:10.1016/j.crm.2017.02.001

Slater, R., Peskett, L., Ludi, E., & Brown, D. (2007). Climate change, agricultural policy and poverty reduction-how much do we know? *Natural Resource Perspectives*, 19.

Slave, C., & Man, C. (2012). The contribution of human activities to climate change. In *Agrarian Economy and Rural Development-Realities and Perspectives for Romania, 3rd Edition of the International Symposium*. The Research Institute for Agricultural Economy and Rural Development (ICEADR).

Tabari, H. (2020). Climate change impact on flood and extreme precipitation increases with water availability. *Scientific Reports*, 10(1), 13768. doi:10.1038/41598-020-70816-2 PMID:32792563

The Economist. (2019, May 4). Global meat-eating is on the rise, bringing surprising benefits. *The Economist*.

Thornton, P. K., & Herrero, M. (2010). *The Inter-linkages between rapid growth in livestock production, climate change, and the impacts on water resources, land use, and deforestation*. World Bank Policy Research Working Paper, WPS 5178. World Bank.

Thornton, P. K., Herrero, M., Freeman, A., Mwai, O., Rege, E., Jones, P., & McDermott, J. (2008). *Vulnerability, climate change and livestock: Research opportunities and challenges for poverty alleviation*. International Livestock Research Institute. ILRI.

Thornton, P. K., Van de Steeg, J., Notenbaert, A., & Herrero, M. (2009). The impacts of climate change on livestock and livestock systems in developing countries: A review of what we know and what we need to know. *Agricultural Systems*, 101(3), 113–127. doi:10.1016/j.agsy.2009.05.002

UNEP (United Nations Environment Programme). (2012). *Global environment outlook 5: Chapter 5*. https://www.unep.org/geo/pdfs/geo5/GEO5_report_C5.pdf

UNFCCC. (2001). *Funding under the Kyoto Protocol. Decision 10/CP.7, FCCC/CP/2001/13/Add.1*. United Nations Framework Convention on Climate Change.

USDA (United States Department of Agriculture). (2013). Climate Change and Agriculture in the United States: Effects and Adaptation. *USDA Technical Bulletin*. https://www.usda.gov/oce/climate_change/effects_2012/CC%20and%20Agriculture%20Report%20%2802-04-2013%29b.pdf

Woods, B. A., Nielsen, H. Ø., Pedersen, A. B., & Kristofersson, D. (2017). Farmers' perceptions of climate change and their likely responses in Danish agriculture. *Land Use Policy*, 65, 109–120. doi:10.1016/j.landusepol.2017.04.007

World Economic Forum. (2020). *60% of the world's fish species at risk of extinction due to climate change*. World Economic Forum. Accessed from <https://www.weforum.org>

WorldFish Center. (2007). *Fisheries and aquaculture can provide solutions to cope with climate change*. *Fisheries and aquaculture can provide solutions to cope with climate change*. Issues Brief 1701, WorldFish Center.

Yahaya, O., & Nwabuogo, O. E. (2016). Renewable energy deployment as climate change mitigation in Nigeria. *Global Journal of Human Social Science*, 16(4). <https://globaljournals.org/item/6195-renewable-energy-deployment-as-climate-change-mitigationin-nigeria>

Zamasiya, B., Nyikahadzoi, K., & Mukamuri, B. B. (2017). Factors influencing smallholder farmers' behavioural intention towards adaptation to climate change in transitional climatic zones: A case study of Hwedza District in Zimbabwe. *Journal of Environmental Management*, 198, 233–239. doi:10.1016/j.jenvman.2017.04.073 PMID:28463773

Chapter 14

Climate Change Lessons for Managers in a Sustainable Economy

Joyce Adefunke Ayeni

 <https://orcid.org/0000-0002-5697-0407>

University of KwaZulu-Natal, South Africa

ABSTRACT

There exists a close link between the natural environment and the world of work. This emphasizes the dependence of the world of work on environmental factors. The world of work does not exist in isolation but hinges on the ecosystem for survival. Climate change and other kinds of ecological squalor have had adverse effects on jobs, the structure of the organisation, work processes, and work efficiency, and with the increase in global warming, these effects are anticipated to be more noticeable in the approaching decades.

INTRODUCTION

There exists a close link between the natural environment and the world of work. This emphasizes the dependence of the world of work on environmental factors. The world of work does not exist in isolation but hinges on the ecosystem for survival. Climate change and other kinds of ecological squalor have had adverse effects on jobs, the structure of the organisation, work processes, and work efficiency, and with the increase in global warming, these effects are anticipated to be more noticeable in the approaching decades. The various kinds of ecological deprivation may impact the world of work directly or indirectly which necessitate the call for proactive initiatives by organisations to tackle climate change.

Despite the urgent need for adaptation to climate change, many organisations are experiencing challenges in ensuring its effectiveness. It is widely believed that three key aspects play a vital role in the relationship between climate change and the world of work. Firstly, jobs largely depend on the services provided by the environments. As climate change looms over the delivery of essential services derived from the environment, it jeopardizes the jobs depending on them. Secondly, the absence of ecological

DOI: 10.4018/978-1-7998-7967-1.ch014

risks and the preservation of ecological stability determines how jobs are executed as well as the provision of healthy, safe, and hazard-free working environments. Thirdly, the perils linked to environmental ruin tend to impact more on susceptible workforces. It is imperative more than ever to invest in climate-resilient structures; the failure of an organisation in adapting, investing, and maintaining a climate-resilient structure will be costly in the long term as the negative impact of climate change increases. It is cost-effective in the long term when appropriate investments are made timely to deal with future climate change occurrences that bring about a reduction in the maintenance and renovation cost.

The focus of this chapter is to present a discussion on the climate change lessons for managers in a sustainable economy. The study, which was conducted through a literature review, investigates the concept of the green economy and climate change, as well as businesses' commitment to advance climate actions in ways that build resilience in organisations. Organisations with both local and international influence who are on a quest to tackle climate exposure need to implement wide-ranging ingenuities and policies that will lessen biodiversity loss, diminish greenhouse gas discharge, enhance climate actions that will reduce the hostile effect from climate change, and boost resource productivity.

DESCRIPTIVE VIEWPOINT ON CLIMATE CHANGE

In this ever-changing global milieu, policy-makers and corporate leaders need to have an understanding of the fact that climate change is primarily a risk management problem, one that entails proactive management, scientific invention, prudent investment, and corporate revolution (McKinsey & Company, 2020). Studies have shown that most people have an astigmatic view and partial understandings of the effects of climate change, and an even slimmer and considerably shallow understanding of what climate change means to their present and future (Stamm, Clark, Eblacas, 2000; Whitmarsh, 2009).

The climate is a conception formed to logically depict the joint conditions of temperature and drizzly situations of an area (Tiefenbacher, 2020). Climate change indicates a diversity of outcomes for organisations in terms of finances, operation, and public relations. Organisations are critical in addressing climate change issues particularly in terms of economic constraint and global finances (Wittneben & Kiyar, 2009). Global climate change is affecting our association with the environment, making the relatively steady climate features uncertain, erratic, and hostile (Ricart et al., 2019). Tiefenbacher (2020) affirms that climate change is causing many serious issues that will impact the peoples' apparent comforts and bluster the basics of our survival. Some of the difficulties linked to climate change are acetifying oceans, the spreading of diseases; growing sea levels; varying circulations of fresh and saltwater; waning levels of cryosphere components; changes in habitat size and distribution; weakening of conservation systems; variation in weather processes; incongruities between climates and soils; disruption in plant and animal life; recurrent decline in global and local food production; and force relocation of people due to climate change hazards. (Tiefenbacher, 2020).

In the current business topography, organisational initiatives towards addressing climate change must be done in conjunction with the swiftly fluctuating social framework. Undeniably, climate change not only reveals the weaknesses in the social landscape and government but also increases the risk in them. Climate change is gravely upsetting the globe through the intensity of tsunamis, droughts, mudslides, floods, heatwaves, earthquakes, and thunderstorms, and wreaking enormous damage on the earth. An exhaustive initiative to climate hazard is significant to concurrently reinforce ecological flexibility and long-term economic. According to Gori et al. (2018), climate change has triggered variations in land use

apart from expending pressure on water resources thus, upsetting the ecosystem's capacity to preserve food production. Climate change poses a grave danger to countries with agricultural economies such as Pakistan (Mumtaz et al., 2019). Pakistan ranks 12th amongst the most vulnerable countries to climate change, (Ullah, 2017) as its agronomy sector is vastly susceptible to climate change (Saleem et al., 2019)

Economic stability and climate stability are intertwined. The world we live in and work in relies on a stable climate but the intensity of climate change threatens the stability of our world. It is imperative to state that all country is susceptible to the rising socioeconomic impacts of climate change in the coming years although poor or struggling countries may experience the biggest risks due to their dependence on natural capital and agronomy for sustenance. Adaptation to climatic changes requires financial provision that the struggling economy might not have which further exposes them to climate risks. Climate risk is innately unstable and has been nullifying the assumptions on stable climate necessary for the effective world of work. It is not only unstable but snowballing at an alarming rate and its impacts manifest over growing upsurges that could have an extensive ripple effect on organisations in various sectors. As a matter of necessity, organizations must take into account the unstable nature of climate change when drafting risk management policies. Despite the perils being experienced through climate change occurrences, many organisations are devoid of a tailor-made climate risk framework that is suitable for them. Investment decisions by many organisations are built on erroneous logic of security where climate change is a concern. The destructive power of flooding is growing due to climate change, which, further brings disturbing human costs, wreaks untold havoc on lands, buildings, and infrastructural amenities.

Attaining a self-bolstering organisational cycle will involve the widening of the climate risk capability. It entails managers putting into consideration the available individual and team expertise, their replicable corporate procedures, and the technological avenues for managing the control system within the organisation.

For managers to act responsibly and effectively to the heightening impacts of climate change, organisations must remain innovative not necessarily technologically. Active collaboration from the government, organisations, and individuals must be initiated and encouraged, which could serve as an avenue for developing an environment that legitimises leaders in all sectors of the economy to be actively involved in tackling climate hazards. Although every organisation is burdened with their specific climate risk initiatives, they are still expected to contribute their quota to the collective initiatives for curtailing climate risk upon the environment.

SUSTAINABILITY MANAGEMENT CULTURE

Sustainability management is the structured implementation of management strategies, procedures, and operations to the tasks of communicating, indicating the background, classifying, evaluating, managing, observing, and appraise risk (Yilmaz & Karakoc, 2008). Sustainable management is described as a value fixated management built on the idea of establishing a sustainable business entity in a sustainable environment (Comgate, 2008). Climate change is a threat to the liveability of the world at large. Effects of climate change adversely influence the economic, social, and ecological systems of the world. Sustainability is ensured when climate change risk is curtailed by an all-inclusive risk management strategy.

Sustainability Management (SM) is not a trend or a once-off occurrence. SM being entrenched in the organisational values is vital for the successful application of the risk management initiatives. Sustainable Management applies to climate change issues. A systematic approach together with collaborative

efforts and dedicated leadership is required for the fusing of climate change into Sustainability Management. The systematic approach will foster the development and execution of effective strategies for the management of climate change issues. According to Comgate Engineering (2008), the sustainability management administration is steady, requiring a constant process of factor recognition, codifying, alleviation, and detailing.

UNDERSTANDING THE LINK BETWEEN SUSTAINABILITY AND CLIMATE CHANGE

An occurrence can impact an organisation positively or negatively and both may be experienced at the same time. While a positive impact may signify prospects and counterweight negative incidents, a negative circumstance may destroy existing value and prevent the creation of new ones. Prospects are the likelihood that an occurrence will arise and influence the realization of objectives positively, safeguarding existing values and supporting the creation of new values (Yilmaz & Karakoc, 2008).

Uncertainty occurs within the framework of the global warming factor assessment, because of the inability to establish the extent of the global warming and lack of clarity regarding their associated effects. Similarly, uncertainty may occur due to decision-makers not knowing the verge at which global warming has a specific degree of consequence for an organization.

Tactics for climate change and sustainable development acclimation possess several mutual rudiments, so tackling them together can generate collaborations. From the proactive point of view, factoring climate change into the development agenda is cost-effective as handling it exclusively is very costly. According to the Brundtland report of 1987, sustainable growth or advancement referred to the growth that satisfies the current demands without jeopardising the capability of fulfilling the demands of the future generations (WCED, 1987). It involves a balanced combination of a comprehensive and practical economy, environmental probity, accountable governance, social unity, and grassroots enablement. Sustainable development also involves enhancing economic growth as an essential environmental value and not a tool for economic stagnation. Economic development enhances the ability to tackle ecological and societal challenges. Vice versa preserving ecological value is crucial for sustainable development.

Economic development usher in a bigger capacity to tackle social and environmental difficulties. The connection between sustainable development and climate change emerges from the fact that climate change hampers development, while sustainable development is vital to the capacities for the alleviation of its impact and adaptation.

Rounded sustainability management in the environment, is significant to every industry, but particularly to global sustainability. Climate change negatively impacts greatly the environmental, social, and economic systems. Climate change hazard is managed by all-inclusive risk administration and offers sustainability. Due to this fact, risk management is a vital feature between sustainability and climate change.

Sustainability management confronts issues originating from environmental and social justice fields which include climate change issues (Anderson, 2009). The sustainability management method is cost-effective for organisations by envisioning and averting expenses arising from climate change. Furthermore, operational costs can be minimised through the abolition of health and safety risks, waste minimization, pollution avoidance (BSD Global, 2008).

EFFECT OF CLIMATE CHANGE ON THE ORGANISATION

In countries such as the Canada, United Kingdom and the United States of America, and some other developed countries of the world, the regional and national structures of various economic sectors have progressed over more than a few hundred years to be suitable and succeed in definite environmental circumstances, mainly regions' climates (Tiefenbacher, 2020). The intensity of climate change is shaking the trusted and tried structures of these countries and cannot be discounted.

The effect of climate change on the organisation can be viewed from two separate but entwined angles. Firstly, from its impact on the employees and its impact on the organisation itself. Climate change has heightened organisational risk and employees' health and safety risk. The human health state can be affected directly or indirectly by global climate change, which has become one of the greatest observable environmental issues of the 21st Century (Melillo, Richmond, Yohe, 2014). As it is synonymous with any swiftly budding matter, organisations encounter huge challenges from risk assessment to readiness planning regarding climate change (Schmidt, 2009).

The workforces are usually susceptible to the impacts of climate change, for extended periods and at a higher fervency compared to the public. While the general public can decide to evade some climate conditions, workers usually do not have such opportunities thereby making them susceptible to the conditions (Kiefer, Rodríguez-Guzmán, Watson, De Joode, Mergler, & Soares da Silva, 2016). The organisational dilemma regarding employees' health and climate change hinges on identifying how climate conditions can affect the health and safety of the employees and developing strategies for abating, reacting, and adapting to the existing and projected effects of climate change.

According to Kiefer et al. (2016), the identification of how climate change can affect employees can be done in many ways but usually, it is realised from three diverse viewpoints:

- Clarification of identified health and safety risks, such as extreme weather conditions, air pollution, heat or hot temperature, communicable diseases, and wildland fire;
- Fresh, unforeseen, or unknown risks, such as upsurges in aeroallergens, broadening communicable disease trajectory ranges, and increase in insecticide usage;
- Hazards that originate from the climate change reaction of man, such as recycling, eco/green industries, the growth of renewable energy, carbon insulation, as well as modifications in how societies and structures are made and preserved (Kiefer et al., 2016).

Climate change is anticipated to generate unparalleled changes in the economics, environment, ecosystem, health, and safety of the general populace, and unveils fresh difficulties on the organisation and its workforce protection from on-the-job hazards (Applebaum et al., 2016; Schulte et al., 2016). These issues are rising as businesses and workers all over the world are struggling with growing economic and social disparity as well as job insecurity (Julià, Vanroelen, Bosmans, Van Aerden, & Benach, 2017).

Organisations in different sectors and employees in various occupational categories have already encountered climate/weather-related perils on their jobs. The rising occurrence, duration, and stringency of extreme weather conditions and additional issues triggered by climate change will worsen these perils. Extreme weather conditions exposed employees not only to occupational hazards but also to community issues such as power outages, damaged roads, and psychological trauma. (Levy & Patz, 2015; Luber & Lemery, 2015). Some organisations lack preventive policies and procedures that permit employees to

halt work processes to evade danger. Enhanced socio-economic strategies and improved readiness of organisations are necessary to curtail these difficulties.

Forms of Climate Change Impact on the Organisation

Climate change is already affecting organisations around the globe and is anticipated to have a greater impact in the future. Some of the examples of ways in which climate change can impact an organisation include the following:

- **Capital Costs for Emission Control Structures**

Climate change has mandated some organisations to spend substantial sums of money on the initiation of emission control structures to fulfill regulatory requirements on greenhouse gas emissions. Energy and utility businesses that run power plants and refineries are most affected by the costs (Folk, 2018).

- **Heightened Public Pressure**

The general public is becoming more and more open to organisations that put in efforts at minimising the environmental effect of climate change as their acceptance and understanding of climate change grows. There is an increased focus on corporate social responsibility with particular emphasis on how organisations conduct their affairs in making the environment more conducive for the public and also supporting environment-focused Non-governmental organisations to improve their reputation of being environmentally responsible. Reputation is vital in the business world as it is a means of achieving a competitive advantage over competitors. Increasingly, customers look for products that are sustainably manufactured or those that have a lesser environmental effect in comparison with others which directly or indirectly increases the pressure on the organisation.

- **Higher Prices for Goods and Services**

As logistics organisations seek alternatives in transporting raw materials and finished goods from one location to another, prices are affected. An increase in the amount spent in transporting goods is passed down to the final consumers which invariably affects the prices of commodities.

- **Increased Hazard due to Extreme Weather**

Experts have associated climate change with a growing rate and increase in extreme weather events such as floods, storms, heatwaves, and droughts (Levin, 2017). Climate change increases organisational risk through extreme weather conditions. As the risk increases, the insurance cost will also surge for many organisations. Severe storms are projected for days to come, with a diversity of adverse effects on organisations. As temperatures increase and weather patterns change, working conditions in some sectors of the economy may become tougher (Folk, 2018). Health and safety risk will increase and jobs will become more challenging particularly for the outdoor workforce. The U.S. states of Washington, Idaho, Alaska, and Oregon, are at the hot spot of climate change. The region known as Federal X has warmed significantly in more than 100 years; while Alaska is the fastest-warming state in the US (Reidmiller

et al., 2018). Across the region, the effects of climate change have been previously experienced. For instance, wildfires and ensuing smoke issues are a rising yearly danger both in occurrence and extent which exposes employees, especially outdoor workers to injurious stages of air pollution (Giles, et al (2017); Gergel et al (2017)).

- **Commitments Under Foreign Regulations**

Multinationals are bound by the extensive climate change regulations in their home countries as well as foreign countries where they operate and they are obligated to conform to these rules and regulations. Rules and regulations designed to curb and avert pollution will also meaningfully affect organisations. For instance, President Trump authorised the withdrawal of the U.S. from the Paris Agreement on climate change in 2017, but that does not exempt American multinationals trading in other countries from their commitments to climate change rules in the 200 other nations that are still part of that agreement.

Forms of Climate-Related Occupational Hazards

Some examples of climate-linked occupational hazards consist of work-related exposure to high temperature and hot environments, extreme weather conditions, air pollution, biological risks, and Indoor climate conditions.

- **Work-Related Exposure to High Temperature and Hot Environments**

Exposure to extended working hours in a hot environment, extremely high temperature, and strenuous work routines are capable of increasing employees' risk for heat stress. Some of the resultant effects of heat stress are exhaustion, stroke, and death. According to a study of the Deepwater Horizon oil spill, clean-up workers (Garzon-Villalba et al., 2016) heat may also heighten the risk of injury.

- **Extreme Weather Conditions**

Extreme weather conditions such as heavy storms, mudslides, floods, landslides, droughts, lightning, wildfires, and cyclones are linked to work-related injuries, illnesses, psychological stress, and death. Workers tasked with the responsibility of rescue, clearing of debris, and restoration such as firefighters are prone to harmful environments during and after extreme weather conditions (Fayad, 2009). Rescue workers' health and safety may be compromised without adequate training and enforcement of safety rules after extreme weather conditions (Campbell, 2017).

- **Air Pollution**

Air pollution has been associated with both severe and chronic health conditions such as allergic reactions, heart disease, and respiratory diseases. Many aspects of the work environment such as weather conditions and worksite setting may result in work-related exposure to air pollution. Warmer temperatures will possibly be the reason for increased cases of air pollution (Fiore, Naik, & Leibensperger, 2015).

- **Biological Risks**

Climate situations such as rain and temperature influence the incidence and spread of allergens, vectors, pathogens, and hosts. Related health challenges comprise mold-related asthma; water-borne and food-borne illnesses; vector-borne disease; asthma and allergies triggered by pollen; and lung and skin irritation from toxic plants. Climate change is widening the range of disease vectors, thus increasing the exposure of various occupational groups such as healthcare workers, construction workers, outdoor workers, emergency responders, and post-disaster remediation (Moore et al, 2017). In agreement with Moore et al. (2017), Luber, Knowlton, Balbus, Frumkin, Hayden, and Hess (2014) assert that outdoor workforces may be more exposed to mosquito-borne diseases, such as malaria, dengue, West Nile, chikungunya, and Zika; and tick-borne diseases, such as Lyme disease.

- **Indoor Climate Conditions**

Indoor climate conditions may impact the health and safety of workers adversely. High temperatures heighten the necessity for climate-regulated buildings. Building-related infections such as sick building syndrome are from time to time linked to indoor air quality. Sick building syndrome may be a result of poor ventilation, dust, poor lighting, the presence of mold or fungus, and chemical contaminants.

Climate changes impact significantly the well-being of employees which necessitate that organisations improve the mental capital of workers and managers to remain productive in periods of change.

CHANGE PROCESS IMPLEMENTATION FOR CLIMATE CHANGE

Change is undoubtedly the most communicated phenomenon across the globe since without change there cannot be any advancement or achievement of stability. Organisations are undergoing unusual transformation due to impacts from internal factors such as work redesign, structure and process redesign, unionism, changing legislature, and organisational lifestyle while the external factors include changing demographics, globalisation, changing customer demands, competition, workers expectations among others (Erasmus, Loedolff, Mda & Nel, 2015). It is pertinent to state that in some cases, the change might require that the organisation start from scratch by going back to the basics to seek fresh methods for success and survival (Erasmus et al., 2015).

Climate, economic, and political instability are all *au fait* fundamentals of the world of work. The challenge is that despite the capricious nature of the present world, many of the available methods and mechanisms for managing and leading are inapt for the current circumstances but are suited to the long-standing, mechanical world view (Cameron & Green, 2015).

Usually, when change is presented in an organisation, employees tend to resist some of the stance taken by the management. Resistance to change is one of the most significant aspects that the management of an organisation needs to focus on during the time of change. It is germane to state that resistance to change requires an enduring process of learning and relearning when introducing change (Erasmus et al., 2015). Managers and employees must learn to cope with this temporariness and change. They need to be flexible, innovative, creative, adaptive, and resilient. Managers must become change agents who proactively anticipate the need for change, initiate and implement it, and the whole employees have to participate fully in the process. Managers must also understand resistance to change and create an organisational culture conducive to change.

There are two main types of strategies that can be used in managing a change process:

Climate Change Lessons for Managers in a Sustainable Economy

- Structural strategies: entails organizational restructuring, job redesign, and job enrichment
- Process strategies: entails survey feedback, team buildings, quality circles, sensitivity training, and career planning

It is crucial that the strategy of change preferred by the organisation suitably align with the organisational need as well as the climate change risk that the organisation is exposed to. Although, factors such as technological advancement, political pressure, and legal restraint may compel the organisation to seek the assistance of organisation development (OD)experts.

MANAGING UNDER CLIMATE CHANGE SCENARIO

The global disclosure system for environmental information by the Carbon Disclosure Project (CDP, 2019) published a report on some of the world's major corporations whose climate risks to their businesses were valued at nearly US\$1 trillion which many will possibly attain in the next 5 years. More than 80% of the corporations involved in the report have had major climate effects, such as rising global temperatures, extreme weather patterns, and amplified valuing of greenhouse gas emissions. The Director of change for CDP, Nicolette Bartlett stated that the direction for climate action is much clearer for organisations given the CDP analysis that depicts a multitude of risks due to climate change such as changes in the market, physical costs from climate effect, reduced assets, and concrete impacts on profitability (CDP, 2019).

Managers are saddled with the responsibility of working with and through people to accomplish the aims and goals of the organisation in a fluctuating environment (Bagraim et al., 2016). Managers as a matter of necessity must have an understanding of the whole organisation and the ability to influence mechanisms, such as people, roles, responsibilities, structure, and technology to realize anticipated outcomes. Managers pursue an alignment between the changing environment and the organisation, with its productivity by altering resources and manoeuvre people's conducts and activities to suit that alignment.

The current business terrain demand that managers understand and boost the vision, strategy, and business model of the organisation by having a broad perception of their role within the organisation. Managers need to approach their job professionally which necessitates an understanding of all business functions and preparing for uncertainty (as the business world is erratic).

Managers work in a multifaceted and challenging environment; therefore, a broad perspective of their jobs is required for success. Climate change presents managers with novel challenges that necessitate a proactive intervention. Daft (2011) proposes that managers need to establish structures, conditions, and an environment that will empower organisations to be effective regardless of the circumstances within and around them. Praphu (2011) affirms in a nutshell that management is about people, about accomplishing tasks through people, and about synchronizing the efforts of individuals to realize organisational objectives and goals. Managers function in an intricate environment that requires them to respond swiftly to demands that are habitually volatile. It is therefore apposite that managers have comprehensive facts about the organisation and its procedures, superior decision-making expertise as well as satisfactory relational skills.

Many employees consider their direct managers to depict what the organisation represents and consequently impact their behaviours, insights, and dedication (Bagraim et al., 2016). The influence of managers on the employees is enormous which places them in a strategic position for the implementation

of a change process. Rapid technological advancements, fluctuating economic conditions, and political disturbances are regular clogs in the wheel of running a business globally which managers have to successfully deal with to achieve organisational goals. Knowledgeable managers have the awareness of the external forces that their organisation is faced with and actively sought the commitment of the employees in handling them. The external forces include rapidity of change, technological advancement, changes in social behaviours, economic and geopolitical uncertainties, governmental regulations among others. The safety of the environment and astute use of natural resources are also progressively viewed as important subjects. Managers pursue an alignment between the organisation and its production with the fluctuating business environment through the reallocation of resources and micromanaging employees' conduct to suit the alignment. Managers often have to respond quickly to erratic demands as they function in a multifaceted business environment. It is then palpable that managers have a thorough understanding of the organisational structure, its processes, policies, legal frameworks, solid relational abilities, and logical decision-making skills (Bagraim et al., 2016).

Managers must have three key focus areas to be a high performer as suggested by Goleman (2013).

Inner Focus: consist of observing personal thoughts and mood, flexibility, emotional self-control, and being attentive

Other Focus: consist of the capacity to sway others, nurturing and persuading, teamwork and co-operation

Outer Focus: consists of the capacity to probe into the broader environment and pursue knowledge about the connection between the various parts of the organisation and the influence of economic, political, macro, technology, and social-environmental on the organisation.

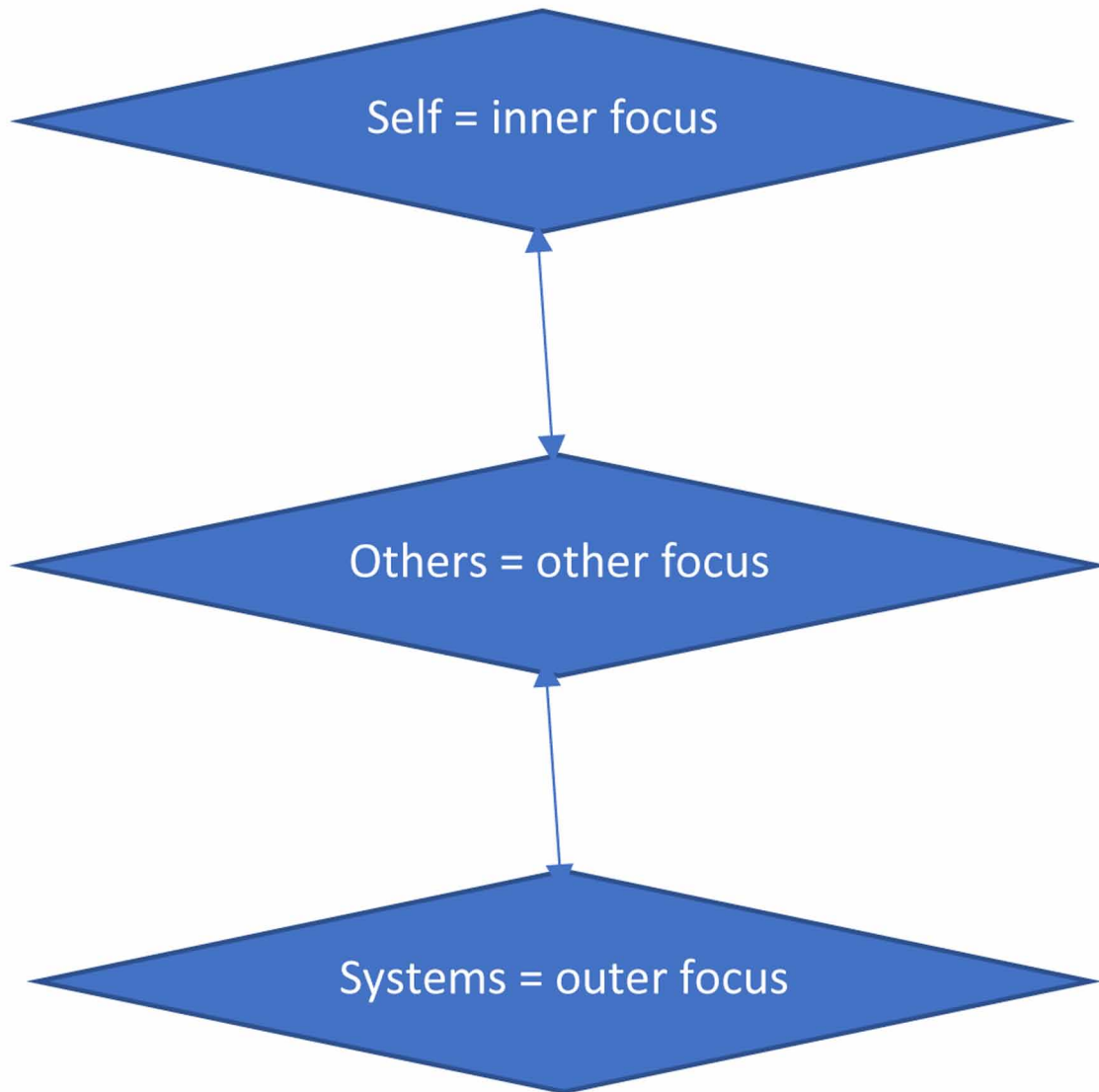
Bases of Managerial Power

Power is a dynamic essential fact of all social relationships. The organisation is a system of power, position, and social relationships, and not only a network of hierarchical structures (Bagraim et al., 2016). Power is the capability to influence others (ASP, 2021). The interactive nature of the relationship between various units in the organisation controls the exercise of power. The source of managers' power is from both their status and their traits. In any organisation, understanding power dynamics adequately, its use, and how to manage it effectively is a necessity for managers (Preston, 2005). A strategy is required to exercise power and effect a change. The minimisation of employee resistance to change and the reduction in managerial misuse of power are the foundations of a power transformation strategy (Bagraim et al, 2016). A manager is expected to have strategies that will ensure the full commitment of the employees to the climate change initiatives with minimal resistance.

According to Bagraim et al, (2016), the two main bases of managerial power are:

- Structural bases of power that include knowledge, networks, resources, and decision making;
- Interpersonal bases of managerial power include reward, coercion, legitimacy, referent, Informational, and expertise.

Figure 1. Focus area



Understanding the bases of power is critical to its application and outcome. It is however pertinent to state that understanding the people being led will enable the manager to make use of the appropriate power in realising organisational goals. For an issue as climate change, usage of one base of power might not achieve the desired outcome therefore, managers will have to consider the peculiarity of their situation and combine the diverse bases of power from both structural and interpersonal viewpoints.

Climate change mostly presents unanticipated challenges and havoc that demands high flexibility from managers with regards to the use of power. Furthermore, when choosing the type of power to apply the

manager needs to ensure that the type chosen is relevant to the situation on the ground and will achieve the expected result. For instance, reward power might be able to achieve what coercive power will not under some circumstances and vice versa. Having adequate and thorough knowledge of an impending disaster or threat by the manager can be enough to sway the minds of the employees to commit to change and achieve the organisational goals. Misuse of power, as well as an inappropriate combination of power bases, could spell doom for an organisation hence, a meticulous evaluation is expected when choosing the sources of power to influence the employees.

COMMON PROBLEMS ASSOCIATED WITH RESPONDING TO CLIMATE CHANGE

Organisations have become progressively alert of their important role in aiding operative, timely, and suitable adaptation. There is a growing awareness of climate change risks among organisations in terms of their operations, customers, suppliers, employees, and the communities in which they operate (UNEP, 2012). Handling climate change encompasses two tactics which are mitigation and adaptation. While mitigation entails curtailing emissions of and steadying the degrees of heat-trapping greenhouse gases in the air; adaptation entails adapting to the current climate change (NASA, 2021).

Adaptation strategy is one of the prominent strategies that organisations develop in dealing with climate change. Adaptation is defined as the changes in environmental, economic, or social systems in response to real or anticipated climatic provocations and their impacts (UNFCCC, 2021). Adaptation aims to lessen our susceptibility to the harmful impacts of climate change (such as extreme weather conditions, sea-level encroachment, among others). It refers to modifications in procedures, practices, measures, and structures to curb possible hazards or to take advantage of prospects linked with climate change (UNFCCC, 2021). There are four major problems associated with the adaptation strategies; Uncertainty, inertia, dynamics, and bifurcations.

Uncertainty

One of the significant hitches for initiating adaptation strategies is addressing uncertainty. According to Hallegatte, Lecocq, and De Perthuis, (2011), this uncertainty comprises of three elements:

- Uncertainty regarding the global status of climate change.
- Uncertainty regarding the local impact of the climate change global status.
- Uncertainty regarding the response of major cycles (such as water), ecosystems, and the social order to global and local climate changes.

It is pertinent to state that when it comes to uncertainty regarding the global status of climate change, the effects of climate change and their associated risks are not equal. Uncertainty is aggravated when evaluating the local impacts of climate change to initiate an adaptation strategy due to the obscurity caused by natural variability. There is also uncertainty concerning the reaction of people and the ecosystems to variations in local climates, which is vital in influencing an effective adaptation strategy.

The three elements of uncertainty need to be included in the adaptation strategy plan from the initial phases. The most productive process for embracing uncertainty is to provide economic shareholders

with authentic evidence on the effects of climate change and to boost methods that sustain flexibility for future action as further information is presented.

Dynamics

The next particularity of adaptation is its dynamic character. Adaptation is not a precise act, intended to move from a steady state to a different steady state. Conversely, the world will have to embrace a climate that will change at a constant rate for many years (Hallegatte et al., 2011). The difficulty is then to understand how and the cost of adapting our lives and our economic structure to a ceaselessly fluctuating climate. In dealing with this difficulty, it is vital to view adaptation as essentially a lasting transitory development.

Inertia

The third significant difficulty of adaptation is the inertia of our socio-economic structures. The difficulty experienced in correcting the adaptation paths made it challenging to consider uncertainty and the dynamic character of adaptation. Nevertheless, several sectors have an enormous inertia level that compelled them in making enduring preferences with protracted outcomes. Resolution vis-à-vis the positioning of assets have mostly lengthened prospects that substantially outlive the installed capital lifecycle. Furthermore, when developing an adaptation plan the different kinds of inertias such as institutional, regulatory, technical, and cultural must be considered:

- Outlining adaptation procedures become more complicated because it is required that actions are taken proactively.
- The intermingling of uncertainty on climate change and the fixed asset lifecycle results in the risk of maladaptation
- Adaptation and climate change have a long span that made it difficult for experiential learning immediately (Hallegatte, et al., 2011).

Bifurcations

The final difficulty for initiating adaptation strategies is linked to the fact that it is either too pricey or technically impractical to adapt in many situations while continuing the same services under a new climate scenario (Hallegatte, et al., 2011). Adaptation to climate change thus may entail “bifurcations” to new actions and/or to new geographical locations. Adaptation procedures must be established within a multisectoral context where general land-use development is considered to correctly forecast these forms of bifurcations. Besides, knowledge revealed that such economic bifurcations regularly consist of difficult glitches regarding employment in particular.

Climate change incessantly presents diverse challenges to the organisation which necessitates that managers and employees must learn to cope with the change. There is a need for flexibility, innovativeness, ingenuity, adaptiveness, and resilience.

CRITICAL PHASES FOR CONSIDERATION BY MANAGERS

A recent report by the Carbon Disclosure Project (CDP) and United Nations Framework Convention on Climate Change (UNFCCC) disclosed that a group of the world's biggest corporations valued jointly at approximately \$17 trillion, have estimated the cost of climate change risks to their organisations at almost \$1 trillion. In contraposition, they estimated possible profits from business opportunities at more than double the cost of climate change risks (UNFCCC, 2019; CDP, 2019). Hence, having potent adaptation strategies in place is crucial to business success.

A haphazard approach to managing climate change will result in dire consequences for an organisation, hence, there are vital steps that managers need to take cognisance of, to ensure effective management of climate change. Yilmaz and Karakoc, (2008) suggested critical phases for consideration in managing climate change issues that are still relevant to managers in the current climate status quo:

- In-depth knowledge of climate change, its effects, and the upshot
- *Ambit* – determining the range of the assessment such as timeframe, topographical margins and actions to be taken.
- *Parties* – defining whose contribution and assessment is vital in managing climate change and is also interested in the upshot of the investigation.
- *Assessment structure* – defining assessment structure for climate change risk that involves the formulation of ideas, setting the organisational achievement standards, creating mechanisms for gauging the costs of climate change, prospects, and risk primacies.
- *Core components* – the establishment of structures that supports the classification of climate change segments through codifying the business activities into focal points and linking them to climate change situations.

In tackling climate change-based issues effectively, it is obligatory to outline the anticipated variation of climate change in the future. This is realized through the use of a climate change synopsis. Climate change situations offer a credible outline of the climate change parameters that are applicable in different locations and periods. The outline can offer a steady and resourceful source for evaluating climate change-affiliated risks across diverse business entities without influencing the probity of the investigation.

Due to some of the initiatives taken previously and currently, there is a better prospect of handling climate change risks successfully, nevertheless, all parties involved need to take account of some fundamental elements such as the inclusion of climate risk into all decision-making processes; the acceleration of the transformation process in managing the risk from past occurrences; and transformation choices and inferences must be incisive.

CASE STUDIES OF GOOD PRACTICE IN CLIMATE CHANGE ADAPTATION

These cases explain the initiation, execution, and institutionalization of resilience-building efforts in tackling climate change within two organisations. Although each organisation deals with adaptation from a unique viewpoint, there are also common patterns that may be useful in guiding other organisations in their implementation process.

- **The Coca Cola Company**

The Coca-Cola Company is a global beverage corporation that operates in more than 200 countries, advertises more than 500 brands and 3,500 beverage products, and sells 1.8 billion servings of beverages daily (UNEP, 2012).

Climate change is viewed as one of the three “mega-trends” of Coca-Cola together with population growth and global development and urbanization while water security is viewed as the most demanding climate change risk. Water is an indispensable component of all beverages and also makes a crucial contribution to the agricultural ingredients that make up the organisation’s products. In dealing with this issue, the leadership of Coca-Cola launches an all-inclusive, universal, quantitative, and qualitative risk assessment.

The risk assessment produces the conception of a system-wide water stewardship platform that has redefined Coca-Cola’s business case for dealing with water demands. Coca-Cola set tangible goals for its water reduction to enhance productivity, treating and recycling the water used in the manufacturing process, and replacing the water used by the company through the engagement in local water stewardship projects in communities where the company operates. Realizing water balance not only aids Coca Cola in the success of its global water stewardship goals, but it also guarantees a sustainable source of water for Coca-Cola products, contributes to the company’s social license to function, and establish a long-term growth path for the company (UNEP, 2012).

- **ESKOM**

Eskom has a wide-ranging adaptation policy that informs its effective response to climate change risks, threats, and opportunities, and is also active in national and global policy discourses on adaptation. Eskom is a South Africa Company that was established in 1923 as the Electricity Supply Commission and produces roughly 95 percent of the electricity used in South Africa.

Even though the nature of Eskom business has constantly made it depend on the collection of climate and weather data for planning and decision making, climate change raises the significance and intricacy of the data collection. Eskom’s facilities, performance, and effectiveness of operations, from electricity generation to transmission and distribution can be negatively affected by floods, intense storms, variations in rainfall patterns and temperatures, droughts, snow, lightning, wind patterns, sea swells, and fires. The growing water scarcity threat in South Africa has arisen as one of the most demanding climate change risks for Eskom. Eskom uses water as a coolant in coal-fired power plants which makes it an essential component in power generation.

The leadership of Eskom commences a climate change vulnerability assessment procedure in 2010 that involved some of their distribution areas and power plants and it was designed to analyse past and present weather situations, climate changeability, and extreme weather events; the effects on Eskom’s productivity; and the efficacy of current adaptation procedures in dealing with evolving issues. The vulnerability assessment procedure produced a comprehensive Climate Change Adaptation Strategy in 2011-2012.

Eskom’s focus on investigating and tackling climate change risks and effects empowers it to provide its customers across South Africa with continuous access to energy which is a vital booster of development. The harmony between Eskom’s sustainable water management strategies and climate change adaptation will guarantee an effective water usage practice.

RECOMMENDATIONS

Combined approaches are vital in lessening the risks of occupational diseases and losses from climate change. An all-inclusive technique to deal with the likely effects of climate change encompasses a balanced and cohesive risk identification and response. (Roelofs, [2018](#)).

- **Organisational Plans**

Organisational policies are key as seen in the case of Coca Cola and Eskom and must deal with fresh and heightened risks caused by climate change. Organisational readiness comprises of:

- Dedicating resources to risk identification;
- Conducting susceptibility valuations to establish employees' and organisational susceptibility to climate change-related hazards;
- Executing a regulatory strategy that eradicates or curtails the effect of the climate change risks;
- Inclusion of occupational health and safety measures into long-term planning of the organisation;
- Initiation of adaptive risk management defines the course of experiential learning and regulating management in response to new evidence, with rules sometimes premeditated as experiments

Figure 1.2 depicts adaptive risk management and adaptive governance strategy for climate change. Generally, adaptive risk management is a prudent approach to climate change decision-making as it utilises an extensive set of ideas and other frameworks and mechanisms, such as cost reduction, cost-benefit, and integrated evaluation (National Research Council, 2010).

Radical modification in work processes, timelines, building safety, the involvement of fire departments in process safety management, and launching of communication medium to contact employees at home may be included in organisational readiness in tackling climate change (Occupational Safety and Health Administration, [2018](#)). The existing comprehensive recommendation for organisations on identified occupational risks such as extreme heat (Jacklitsch, Williams, Musolin, Coca, Kim, & Turner, [2016](#)) may need to be modified for climate change-related risks (Bethel, Spector, & Krenz, [2017](#)).

- **Prevention through Building Design**

Climate change hazards demand that building design plans are modified in a preventive manner to entrench employees' health and safety into constructing a more adaptable and energy-saving structure. Additionally, building codes and standards for workplace structures that were formerly fixated on energy-saving tactics can be altered to conform to ventilation and other health needs of the employees (NIOSH, [2018](#)).

- **Research**

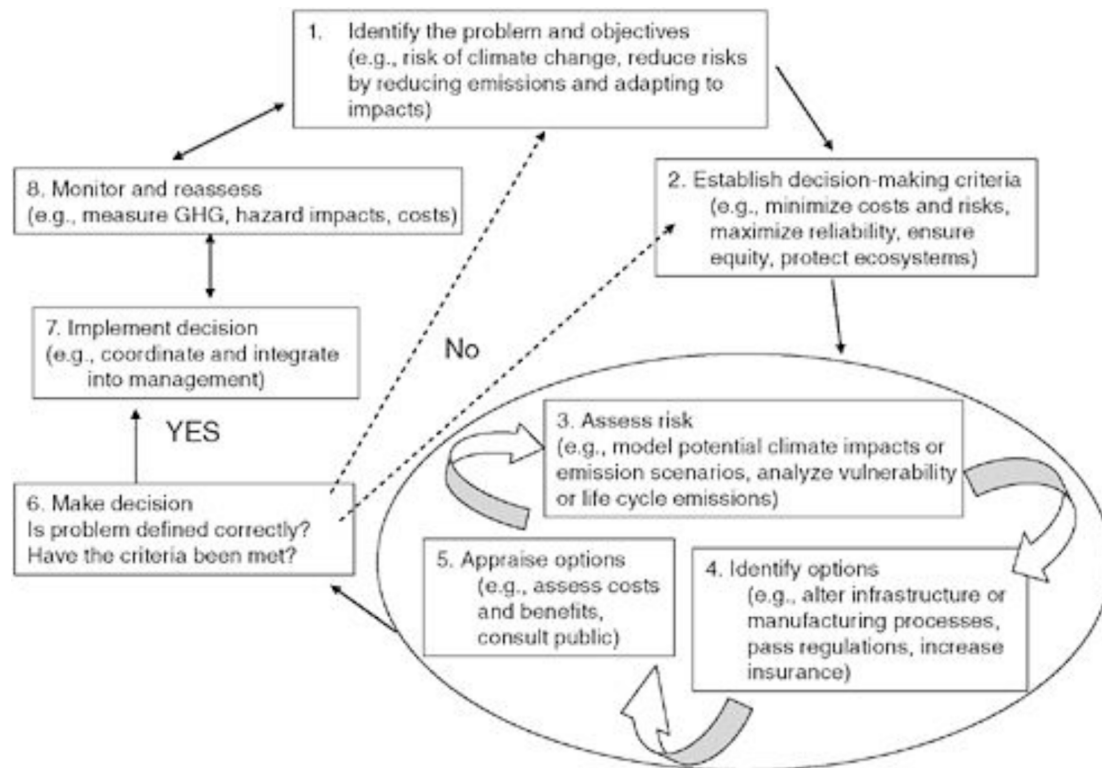
Research on climate change is crucial in presenting evidence-based data for the mitigation of its hazards. Research on occupational health and safety should be enlarged to embrace:

- Examining climate change-related risks and vulnerable people;

Climate Change Lessons for Managers in a Sustainable Economy

- Piloting the research plans through the usage of surveillance statistics on injuries, diseases, occupational hazards, and organisation risk statistics; and
- Initiating, executing, and appraising new adaptation procedures (Adam-Poupart et al., 2013).

Figure 2. Adapted from Willows and Connell (2003)



Existing researches lay the foundation for future studies that can significantly address the impact of climate change on the organisation. According to Kiefer, et al. (2016), further research should focus on investigating the connection between employees and climate change, establish susceptible workforce groups, determine suitable surveillance and gauges, improve hazard communication techniques, and examine the efficiency of control mechanisms. Effective handling of these research requirements may result in enhanced awareness of the upshots of climate change on the organisation and employee's health. Many organisations have recognised the impact of research in tackling climate change. For instance, Eskom collaborates with climate change researchers at the Northwest University, University of KwaZulu-Natal, University of Cape Town, and the Council for Scientific and Industrial Research in South Africa to use climate modelling researches to detect and prioritize the most susceptible "hot spots" in Eskom's operations (UNEP, 2012). China Minmetals Corporation, Agbar group of companies, and Nokia have all team up with A-league universities to advance innovative technologies that will aid them in dealing with serious climate change adaptation issues (UNEP, 2012).

Training

Climate change-related organisational risk exposure and employee health and safety matters can be addressed through training. Climate change risk assessment screening and occupational health and safety (OHS) experts can assist the organisation in evaluating the training needs of the organisation. Once the training needs have been established, a new climate change inclusive training program can either be developed or include a climate change aspect to the current organisational training program. New training initiatives will aid the awareness of employees regarding fresh and heightened climate change risks while also communicating the necessary changes to work activities to deal with the risks. (Nag, Dutta, & Nag, 2013; Singh, Hanna, & Kjellstrom, 2013).

- **Public Health Surveillance**

According to World Health Organisation (2021), public health surveillance is “*An ongoing, systematic collection, analysis and interpretation of health-related data essential to the planning, implementation, and evaluation of public health practice*”. Surveillance is done to enlighten stakeholders on disease prevention and control procedures. Surveillance can also serve as a means of identifying the effect of climate change on the organisation and the workforce health and safety; aid the initiation of the research plan, assist in strategizing, implementing, and assessing preventive policies. New methods of public health surveillance are necessary as the existing practice of employers’ reporting to government agencies is inadequate to successfully ascertain the effect of climate change on health and safety (Harduar Morano et al., 2017). Centers for disease control and prevention (CDC, 2019) Building Resilience Against Climate Effects (BRACE) Framework highlights five sequential steps that can assist managers in dealing with climate-related occupational health and safety hazards:

Step 1: Anticipate climate impacts and assessing vulnerabilities

Step 2: Project the disease burden

Step 3: Assess public health interventions

Step 4: Develop and implement a climate and health adaptation plan

Step 5: Evaluate impact and improve quality of activities

- **Workplace Ethics and Policies**

The workplace ethics and policies focus on organisational development and execution of strategies to avert climate change-related occupational hazards. It also involves the application of safety rules for hazards triggered by extreme weather conditions to more employees and work-related circumstances as the case may demand. Improvement of the strategies to boost employer awareness of climate change-related occupational hazards is essential (Lucchini et al., 2017).

CONCLUSION

Climate change is already having severe effects and will continue to seriously influence the eco-system, human health, environment, agriculture, and society in general. Several organisations engage in more talk and less action about addressing the climate change surge. Many factors have been established to

cause climate change with a particular focus on a simple, pragmatic approach to curb it. The application of the adaptive risk management and sustainability management (SM) approach is essential in dealing with climate change successfully.

Continuous research on climate change to enhance the knowledge of its impact on workforce health and safety can advance the success of the circumvention plans. A detailed research methodology can offer an improved comprehension of the effect of climate change and the appropriate action plan to extensively forecast, identify, communicate, and manage its risks and curb their impact on employees' health.

In conclusion, developing adaptability among the employees will entail increasing consciousness among the affected sectors, initiating precautionary measures, planning and executing adaptation strategies. To successfully defend the organisation and employees' lives from the climate change tragedies, affected sectors must provision and be ready to respond swiftly. A cross-sectoral strategy and comprehensive stakeholder contribution are needed to ensure the involvement of the workforce in guarding against the adverse effect of climate change.

REFERENCES

- Adam-Poupart, A., Labrèche, F., Smargiassi, A., Duguay, P., Busque, M. A., Gagné, C., & Zayed, J. (2013). Climate change and occupational health and safety in a temperate climate: Potential impacts and research priorities in Quebec, Canada. *Industrial Health, 51*, 68–78. doi:10.2486/indhealth.2012-0100 PMID:23411758
- Akanbi, B. E., Adagunodo, M., & Satope, B. F. (2014). Climate Change, Human Development and Economic Growth in Nigeria. *International Journal of Humanities and Social Science, 4*, 1–7.
- Anderson, D. R. (2009). Corporate Survival: The Critical Importance of Sustainability Risk Management. *The Journal of Risk and Insurance, 76*(4), 955–961.
- Applebaum, K. M., Graham, J., Gray, G. M., LaPuma, P., McCormick, S. A., Northcross, A., & Perry, M. J. (2016). An overview of occupational risks from climate change. *Current Environmental Health Reports, 3*(1), 13–22. doi:10.1007/40572-016-0081-4 PMID:26842343
- Applied Social Psychology (ASP). (2021). *Power in Organizations*. Available at: <https://sites.psu.edu/aspsy/2017/02/22/power-in-organizations/>
- Bagraim, J., Cunningham, P., Potgieter, T., & Viedge, C. (2016). *Organisational Behaviour: A contemporary South African perspective* (4th ed.). Van Schaik Publishers.
- Bethel, J. W., Spector, J. T., & Krenz, J. (2017). Hydration and cooling practices among farmworkers in Oregon and Washington. *Journal of Agromedicine, 22*(3), 222–228. doi:10.1080/1059924X.2017.1318100 PMID:28402203
- Cameron, E., & Green, M. (2015). *Making sense of change management* (4th ed.). CPI Group (UK) Ltd.
- Campbell, A. F. (2017). *All the relief money in the world won't rebuild Houston. Undocumented workers will*. Available at: <http://www.Vox.com>

- Carbon Disclosure Project (CDP). (2019). *World's biggest companies face \$1 trillion in climate change risks*. Available at <https://www.cdp.net/en/research/global-reports/global-climate-change-report-2018>
- Comgate Engineering Ltd. (2008). *Risk Management*. Retrieved from: <http://www.comgate.com/risk-mgmt/risk.html>
- Daft, R. (2011). *The Leadership Experience* (5th ed.). South Western: Cengage.
- Day, G. S., & Schoemaker, P. J. (2016). Adapting to fast-changing markets and technologies. *California Management Review*, 58(4), 59–77. doi:10.1525/cmr.2016.58.4.59
- Environmental Protection Agency (EPA). (2019). *Managing Air Quality - Control Strategies to Achieve Air Pollution Reduction*. Available at: <https://www.epa.gov/air-quality-management-process/managing-air-quality-control-strategies-achieve-air-pollution>
- Erasmus, B., Loedolff, P., Mda, T., & Nel, P. (2015). *Managing training and development* (7th ed.). Cape Town: Oxford University Press Southern Africa (Pty) Ltd.
- Fagerholm, F., Hellas, A., Luukkainen, M., Kyllönen, K., Yaman, S., & Mäenpää, H. (2018). Designing and implementing an environment for software start-up education: Patterns and anti-patterns. *Journal of Systems and Software*, 146, 1–13. doi:10.1016/j.jss.2018.08.060
- Fayard, G. M. (2009). Fatal work injuries involving natural disasters, 1992–2006. *Disaster Medicine and Public Health Preparedness*, 3(4), 201–209. doi:10.1097/DMP.0b013e3181b65895 PMID:20081416
- Fiore, A. M., Naik, V., & Leibensperger, E. M. (2015). Air quality and climate connections. *Journal of the Air & Waste Management Association*, 65(6), 645–685. doi:10.1080/10962247.2015.1040526 PMID:25976481
- Folk, E. (2018). *How Climate Change Will Affect Businesses*. Available at: <https://www.renewableenergymagazine.com/emily-folk/how-climate-change-will-affect-businesses-20181109>
- Garzon-Villalba, X. P., Mbah, A., Wu, Y., Hiles, M., Moore, H., Schwartz, S. W., & Bernard, T. E. (2016). Exertional heat illness and acute injury related to ambient wet bulb globe temperature. *American Journal of Industrial Medicine*, 59(12), 1169–1176. doi:10.1002/ajim.22650 PMID:27779310
- Gergel, D. R., Nijssen, B., Abatzoglou, J. T., Lettenmaier, D. P., & Stumbaugh, M. R. (2017). Effects of Climate Change on Snowpack and Fire Potential in the Western USA. [Google Scholar]. *Climatic Change*, 141(2), 287–299. doi:10.1007/10584-017-1899-y
- Gilles, N. G., Foster, J., Dalton, M. M., Mote, P. W., Rupp, D. E., Stevenson, J., Serafin, K. A., Evans-Wilent, J., Ruggiero, P., & Abatzoglou, J. T. (2017). Responding to Climate Variability and Change in the Pacific Northwest United States: The Pacific Northwest Climate Impacts Research Consortium, September 2010–August 2017 Phase 1 Final Report. The Pacific Northwest Climate Impacts Research Consortium (CIRC).
- Goleman, D. (2013). *The three kinds of focus every leader needs*. Available at <http://www.haygroup.com/>
- Gori, A., Brito, C. B., & Ruiz, J. (2018). Climate change and agriculture: Do environmental preservation and ecosystem services matter? *Ecological Economics*, 152, 27–39. doi:10.1016/j.ecolecon.2018.05.013

Climate Change Lessons for Managers in a Sustainable Economy

Groysberg, B., Lee, J., Price, J., & Cheng, J. (2018). The leader's guide to corporate culture. *Harvard Business Review*, 96(1), 44–52.

Hallegatte, S., Franck Lecoq, F., & De Perthuis, C. (2011). *Designing Climate Change Adaptation Policies: An Economic Framework*. Available at: <https://openknowledge.worldbank.org/bitstream>

Harduar Morano, L., Jagger, M. A., Barrett, E. C., Berisha, V., Borjan, M., & Heitziniger, K. (2017). CSTE Climate and Health Syndromic Surveillance Workshop. In *Syndromic surveillance climate and health guidance document*. Braintree, MA: International Society for Disease Surveillance.

International Labour Organisation (ILO). (2018). *The employment impact of climate change adaptation*. Available at: <https://www.ilo.org/wcmsp5/groups/public/>

Investopedia (2020). *7 Ways Climate Change Affects Companies*. Available at: <https://www.investopedia.com/financial-edge/0210/7-ways-climate-change-affects-companies.aspx>

Jacklitsch, B., Williams, W. J., Musolin, K., Coca, A., Kim, J.-H., & Turner, N. (2016). *Criteria for a recommended standard: Occupational exposure to heat and hot environments; Revised criteria 2016*. National Institute for Occupational Safety and Health.

Julià, M., Vanroelen, C., Bosmans, K., Van Aerden, K., & Benach, J. (2017). Precarious employment and quality of employment in relation to health and well-being in Europe. *International Journal of Health Services: Planning, Administration, Evaluation*, 47, 389–409.

Kiefer, M., Rodríguez-Guzmán, J., Watson, J., De Joode, B. V., Mergler, D., & Soares da Silva, A. (2016). Worker health and safety and climate change in the Americas: Issues and research needs. *Revista Panamericana de Salud Pública*, 40(3), 192–197. PMID:27991978

Levin, K. (2017). *Extreme Weather: What's Climate Change Got to Do With It?* Available at: <https://www.wri.org/blog/2017/09/extreme-weather-whats-climate-change-got-do-it>

Levy, B. S., & Patz, J. A. (Eds.). (2015). *Climate change and public health*. Oxford University Press. doi:10.1093/med/9780190202453.001.0001

Luber, G., Knowlton, K., Balbus, J., Frumkin, H., Hayden, M., & Hess, J. (2014). Human health. In J. M. Melillo, T. C. Richmond, & G. W. Yohe (Eds.), *Climate change impacts in the United States: the third National Climate Assessment* (pp. 220–256). Academic Press.

Luber, G., & Lemery, J. (2015). *Global climate change and human health: From science to practice*. Jossey-Bass.

Lucchini, R. G., Hashim, D., Acquilla, S., Basanets, A., Bertazzi, P. A., Landrigan, P. J., & Todd, A. C. (2017). A comparative assessment of major international disasters: The need for exposure assessment, systematic emergency preparedness, and lifetime health care. *BMC Public Health*, 17(46), 46. doi:10.1186/12889-016-3939-3 PMID:28061835

McKinsey & Company. (2020). *The five lessons from our annual Global Sustainability Summit*. Retrieved from: <https://www.mckinsey.com/business-functions/sustainability>

Melillo, J. M., Richmond, T. C., & Yohe, G. W. (2014). Climate change impacts in the United States: the third National Climate Assessment. *US Global Change Research Program*. Available at: <http://bit.ly/2014climate>

Mettler, T., & Wulf, J. (2019). Physiolytics at the workplace: Affordances and constraints of wearables use from an employee's perspective. *Information Systems Journal*, 29(1), 245–273. doi:10.1111/isj.12205

Mills, E. (1998). *The Coming Storm Global Warming & Risk Management*. Available at: <https://eetd.lbl.gov/EMills/PUBS/comingstorm.html>

Moore, K. J., Qualls, W., Brennan, V., Yang, X., & Caban-Martinez, A. J. (2017). Mosquito control practices and Zika knowledge among outdoor construction workers in Miami-Dade County, Florida. *Journal of Occupational and Environmental Medicine*, 59, e17–e19.

Mumtaz, M., Puppim de Oliveira, J. A., & Ali, S. H. (2019). Climate change impacts and adaptation in the agricultural sector: the case of local responses. *Clim. Change Agric*, 1-14. doi:10.5772/intechopen.83553

Naden, C. (2021). *Assessing the risk of climate change*. Available at: <https://www.iso.org/news/ref2625.html>

Nag, P. K., Dutta, P., & Nag, A. (2013). Critical body temperature profile as indicator of heat stress vulnerability. *Industrial Health*, 51, 113–122.

National Aeronautics and Space Administration (NASA). (2021). *Responding to climate change*. Available at: <https://climate.nasa.gov/solutions/adaptation-mitigation/>

National Institute for Occupational Safety and Health (NIOSH). (2018). *Emergency responder health monitoring and surveillance (ERHMS)*. Centers for Disease Control and Prevention.

National Research Council. (2010). *Informing an Effective Response to Climate Change*. Washington, DC: The National Academies Press. doi:10.17226/12784

Occupational Safety and Health Administration (OSHA). (2018). *Emergency preparedness and response*. Author.

Pradeep, D., & Prabhu, N. (2011). The relationship between effective leadership and employee performance. *Journal of Advancements in Information Technology*, 20, 198–207.

Preston, P. (2005). The power image: Strategies for acting and being powerful. *Journal of Healthcare Management*, 50(4), 222–225.

Reidmiller, D. R., Avery, C. W., Easterling, D. R., Kunkel, K. E., Lewis, K. L. M., Maycock, T. K., & Stewart, B. C. (2018). *Impacts, Risks, and Adaptation in the United States: The Fourth National Climate Assessment* (Vol. 2). U.S. Global Change Research Program.

Ricart, S., Olcina, J., & Rico, A. M. (2019). Evaluating Public Attitudes and Farmers' Beliefs towards Climate Change Adaptation: Awareness, Perception, and Populism at European Level. *Land (Basel)*, 8, 4.

Roelofs, C. (2018). Without warning: Worker deaths from heat 2014–2016. *New Solutions*, 28(2), 344–357.

Schmidt, C. W. (2009). Beyond mitigation: Planning for climate change adaptation. *Environmental Health Perspectives*, 117(7), 306–309.

Climate Change Lessons for Managers in a Sustainable Economy

Schulte, P. A., Bhattacharya, A., Butler, C. R., Chun, H. K., Jacklitsch, B., Jacobs, T., & Wagner, G. R. (2016). Advancing the framework for considering the effects of climate change on worker safety and health. *Journal of Occupational and Environmental Hygiene*, *13*, 847–865.

Singh, S., Hanna, E. G., & Kjellstrom, T. (2013). Working in Australia's heat: Health promotion concerns for health and productivity. *Health Promotion International*, *30*, 239–250.

Tollman P. Reeves M. Wallenstein J. Cook P. Berriman C. (2020). Available at: <https://www.bcg.com/publications/2020/reflections-on-leadership-during-crisis>

Ullah, W., Nihei, T., Nafees, M., Zaman, R., & Ali, M. (2017). Understanding climate change vulnerability, adaptation and risk perceptions at household level in Khyber Pakhtunkhwa, Pakistan. *International Journal of Climate Change Strategies and Management*, *10*, 11.

United Nations Environment programme (UNEP). (2012). *Business and Climate Change Adaptation: Toward Resilient Companies and Communities*. Available at: https://unglobalcompact.org/Issues/Environment/Climate_Change/

United Nations Framework Convention on Climate Change (UNFCCC). (2019). *Major Companies Face USD 1 Trillion in Climate Risks*. Available at: <https://unfccc.int/news/major-companies-face-usd-1-trillion-in-climate-risks>

United Nations Framework Convention on Climate Change (UNFCCC). (2021). *What do adaptation to climate change and climate resilience mean?* Available at: <https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/what-do-adaptation-to-climate-change-and-climate-resilience>

World Health Organisation (WHO). (2021). *Public health surveillance*. Available at: https://www.who.int/immunization/monitoring_surveillance/burden/vpd/en/

Yilmaz, A. K., & Karakoc, T. H. (2008). Sustainability management based approach to global warming: Cgw Model and global warming factor score formula. *Journal of Management Research*, *1*, 1–18.

Chapter 15


Climate Change and the Sustainability of Small Businesses in Africa

Thabiso Sthembiso Msomi

 <https://orcid.org/0000-0002-8500-2624>

Durban University of Technology, South Africa

Odunayo Magret Olarewaju

 <https://orcid.org/0000-0002-4366-040X>

Durban University of Technology, South Africa

ABSTRACT

This chapter examined the role of climate change in the sustainability of small businesses in Africa, as climate change is a serious challenge. Severe weather events have the ability to interrupt supply chains, making it more difficult for companies to access materials and resources. Climate change is rapidly becoming the most urgent problem facing humanity in the 21st century. Despite rapid efforts in the mitigation of climate change, there are rising global impacts of climate change. Small businesses remain a source of economic growth and social development in African countries irrespective of the global impact of climate change. Thus, African countries should embark on a reasonable transition to a low-carbon, climate-resistant, or environmentally sustainable economy such that small businesses are turned to small green domestic companies.

BACKGROUND

The critical role of small and medium-sized enterprises (SMEs) has remained significant and prominent in many ways in both developed and developing countries (Nyamrunda & Freeman, 2021). This sector has probably been attached not only to grassroots growth in the economy, but also to the formation of inclusive sustainable development of an unprecedented dimension. There is also no indication that most established countries around the world attributed their economic development and growth to the

DOI: 10.4018/978-1-7998-7967-1.ch015

establishment and funding of a strong SME sector (Biggeri, Anand, Fennell & Comim, 2020). Experiences have therefore demonstrated that governments in advanced countries continue to promote and give preferential treatment to the sector (Banwo, Du & Onokala, 2017). Building on this experience, developing countries have also taken notice of this fact, recognising and acknowledging that the SME sector is a key factor in driving required economic and social development (Adam & Musah, 2015). In particular, the importance of the SME sector has been identified by South Africa as a powerful factor in the mission for economic growth and development (Leboea, 2017). It is therefore not shocking, in view of its respected position in boosting poverty alleviation and unemployment, which recently has become terrifying, that significant policy and programming efforts, including ongoing centered and imperative attention to help the SME sector, have been seen (Maduku, Mpinganjira & Duh, 2016). The production of the SME sector has also been a key driving force of economic post-season and growth in other developed countries (Mathu & Tlare, 2017). This recognition is extremely crucial since the worldwide SME sector is seen to be vital in stimulating economic growth through various methods such as wealth creation, poverty reduction and job creation (Mamabolo, Kerrin & Kele, 2017).

The creation of the SME sector, which would be the way to go if a country really wants growth from the grassroots, is definitely very important (Nyamrunda & Freeman, 2021). It is not only a major source of job growth, but, if harnessed properly, generates substantial export and domestic earnings. In addition, it is considered to be a significant, crucial instrument in the effort to reduce poverty, and its success through coordinated efforts would ultimately provide a giant basis for sustainable economic growth (Adam & Musah, 2015). Pertinently, SMEs are an important part of the economic structure of a country and their success is likely to influence the well-being of a nation as they represent the engine compartment for job formation, economic growth and innovation (Biggeri et al., 2020). Interestingly, it is regarded as an incubating medium for developing entrepreneurship that, by providing both backward and forward linkages for products and services, actually complements the process of adjustment in large companies (Leboea, 2017). The sector includes a wide variety of businesses of varying dynamism, technical development, risk attitudes, many of which are reasonably constant in technology and size, and others are more technologically sophisticated, filling vital niches of goods and services (Bibri & Krogstie, 2017). At present, SMEs are working in a world that is becoming more complex and competitive in terms of threats, markets and technological advancements (Ju, Ferreira & Wang, 2020). There is, therefore, a compelling need to guarantee that SMEs are becoming more competitive by careful management of dwindling resources, generating accurate planning, monitoring, decision-making, risk management and better assessment systems (Saah, 2019). With the increasingly intense rivalry constantly induced by the evolving nature of the operational environment, an insightful incorporation of all of these by an organisation will inevitably reinforce its capacity to gain competitive advantage (Biggeri et al., 2020). As such, optimum cost effectiveness, maximisation of benefit, reduction of risk and creating a competitive advantage are among the main goals SMEs are now trying to achieve strategically in the long and short term (Katz & Green, 2018).

However, in addition to its vital and positive position, many SMEs in Africa face numerous challenges, from the shortage of power, the lack of resources, incompetence in management, inadequate knowledge and ever-changing climate (Muriithi, 2017). A combination of high exposure to climate change and low adaptability has severely impacted businesses on the African continent. There are indeed a number of consequences of climate change on businesses (Wright & Nyberg, 2017). On the one hand, it tends to create a number of new business risks. In addition to the most apparent physical risks (for instance, operational effects of extreme weather events or supply disruptions caused by water depletion), businesses

are subject to transition risks arising from the reaction of society to climate change, such as technological changes, markets and regulation that can significantly raise business costs and weakening feasibility of existing products and services. Another climate-related risk to businesses is the potential liability for greenhouse gas emissions (GHG emissions). According to Bruno, Bates, Cacciapaglia, Pike, Amstrup, van Hooidek, Henson and Aronson (2018), climate change is threatening to disrupt almost every sector, from health to finance to agriculture production and education. Uncontrolled global warming is not only a natural catastrophe, but also economic, from the decline of jobs, higher costs of materials to complicating delivery. In a scenario of 2,5C increasing temperature, 15% of the global gross domestic product (GDP) is projected to decrease, according to Oo, Zin and Kyi (2019). This reflects a loss of more than \$9 billion and 1.2 billion jobs due to global warming alone (Gu, Zhang, Li, Chen, Singh, Zhang, Liu, Shen and Yu, 2020). Indeed, climate change is an ongoing global issue which calls for a global solution (Gu et al., 2020). It is connected to several physical activities, consumer expectations, regulatory standards and varying degrees of uncertainty. The consequences of climate change are immense around the world. Climate change has a significant effect across the world for example in Africa, where harvests are disrupted and agricultural production is endangered (Hoogendoorn & Fitchett, 2018). This has affected farmers and led to increased food insecurity (Hempson, Archibald & Bond, 2017).

Scholars such as Lee and Klassen (2016), Galbreath, Charles and Oczkowski (2016), Bui and De Villiers (2017) have acknowledged the urgency of climate change co-operation in relation to business operation. Businesses, especially small enterprises, are unable to work smoothly without good and stable weather, because unforeseen weather will have a direct effect on businesses, such as flooding and wildfires. This can cause substantial damage, especially to small firms, and may affect business activities. As companies have the potential to have a positive or negative impact on the environment, they also often make a major contribution to climate change. Through heating and air conditioning systems, chemical products, huge volumes of waste paper and outdated electrical apparatus that ends on sites and causes damage to the whole world, and impacts climate change, millions of tons of GHG is generated every year (Bhattacharyya & Barman, 2018).

Enterprises need to make a meaningful contribution to this issue by taking action to promote green practice. Furthermore, consumers are no longer happy only with decent products and customer service. They want to understand from where the commodity comes and how it can contribute to the fight against GHG emissions. They are asking and opting for green products which are more environmentally-friendly and better to use (Yue et al., 2017). The transition starts with the implementation of small steps such as reducing energy consumption, reducing waste, making the most productive use of raw materials and avoiding pollution, especially risky gases. This can allow small businesses to step forward and work towards adequate solutions.

STATEMENT OF THE PROBLEM

SMEs are a critical component of creativity and inclusion in the African economy (Abisuga-Oyekunle, Patra & Muchie, 2020). SMEs also face sustainable development concerns due to climate change, despite their commitment to the underdeveloped and developing countries of Africa (Gbandi & Amisah, 2014). There is a chance of any business being impacted by climate change. Climate change is related to several sustainable problems related to habitat creation and the depletion of land. For example, energy conservation, air pollution, resource depletion such as petroleum, foods, fish, coal, uranium, renewable

energy sources identification and development, land mass submersion, water shortages, population growth, disease spreads and habitat disruptions (Swart, Robinson & Cohen, 2003). Unfortunately, these climate change sustainability issues directly impact business operations, which causes small businesses to be unsustainable both operationally and financially (Libell, 2018). These businesses have not been able to be resilient to impacts of the ever-changing climate due to less support given to small business for sustainability (Libell, 2018).

Notwithstanding the intensification stated above, little attention seems to be paid to this field of research, particularly in the sense of climate change in Africa amongst small businesses, thus creating a research gap. The goal of the research is to provide a broad understanding of the type of issue at hand in developing countries in Africa. Given that limited studies have been undertaken on the same subject on the African continent, this research will contribute to the subject as a new understanding of climate change on sustainability of small businesses around the world. In addition to the findings of this study, it will be important to strengthen understanding of the basic sustainability of small businesses during climate changes. The purpose of this study would then be to bridge the gap described above by providing more information on the impacts of climate change on sustainability of small businesses on the continent by investigating the undisturbed one and reproducing the current one in African countries. Finally, the results will offer insights into the effect of climate change on sustainability of small businesses and help small businesses to improve their sustainability towards being resilient to climate change.

OVERVIEW OF SMES IN AFRICA

SMEs in Africa are known as the base of world economy stability (Adisa, Abdulraheem & Mordi, 2014). Small businesses are now the source of economic growth and social development in all African countries (Baranova & Paterson, 2017). Small businesses in Africa are increasingly in desperate need of services and economic development but are facing a number of problems far beyond the difficulties their counterparts face in developed countries (Cramer, Sender & Oqubay, 2020). SMEs account for nearly two-thirds of the formally working population of the continent, according to research conducted by the Johannesburg Business School in 2019. Africa grew despite the global recession and it shows no signs of abating. The continent is on course to achieve economic growth of around 4.5% this year, a rate higher than predicted for the mature economies of the world (WEFORUM, 2015).

It is noteworthy that most African governments offer very little support to SMEs, thus neglecting a crucial economic cause, and should form development pillars. There has been tremendous growth in the African continent over the last few decades compared to the rest of the world (Muriithi, 2017). African growth has averaged more than 5%, far above the US, Europe and South America, for example, since the rest of the global economy was struggling with economic growth over the past ten years (Muriithi, 2017). Whereas the growth of certain countries such as Angola, Rwanda and Malawi have been uniformed across the continent, others such as Zimbabwe are still in battle (Misati, Walumbwa, Lahiri & Kundu, 2017). The overall growth in Africa however has attracted several investors, particularly in international countries, with direct investment, a process that is expected to further boost long-term economic growth. SMEs, both for emerging and industrialised economies, are the engine pushing world economies and the steppingstone to industrialisation (Hervé, Schmitt & Baldegger, 2020). In developing economies, formal SMEs contribute up to 40% of the national income (GDP). When informal SMEs are included, these numbers are considerably higher. It is projected that 600 million jobs will be required by 2030

to absorb the increasing global workforce, making SME growth a top priority for many governments around the world. Most of the formal employment in emerging economies is created by SMEs, which create seven out of 10 jobs (Salisu & Abu Bakar, 2019).

LITERATURE REVIEWS: DIFFERENT CONCEPTS

Supporting SMEs' Resilience to Climate Change Impacts

SMEs are most vulnerable to the effects of climate change (Deen-Swarray, Moyo & Stork, 2013). Welsh (2016) acknowledged that communities around the world, especially in vulnerable and poor communities in developing countries around Africa, have already experienced the impact of a warm climate. Chirambo (2017) noted that at the COP21 climate summit, countries are negotiating a formal international agreement aiming to mobilise funds to boost adaptation to climate change for those countries which already have and will soon suffer from climate change. Kais and Islam (2016) opined that public financing would probably fill most of this need, but it will ultimately be necessary for companies to participate in this void. Making use of the roles of the private sector must help communities' resilience to climate change in developing countries. According to a World Bank report (2020), more than 60% of the GDP is produced by private sectors in most countries, and about 60% is provided by SMEs. The agricultural sector is particularly vulnerable to extreme weather changes. Moreover, when billions of people rely on SMEs for their livelihoods, supporting this segment of the economy is vital to helping societies to adjust to climate change (Ngin, Chhom & Neef, 2020).

O'Brien (2018) was of the view that since the majority of the population of the developing world relies on SMEs for their livelihoods, this segment of the economy needs to become more resilient to future climate impacts. SMEs at the same time are well equipped to create and market goods and services that improve the resilience of marginalised communities (Bruno et al., 2018). United Nations Development Programme (UNDP) has helped more than 40 countries around the world respond to climate change in small businesses (Dellmuth, Gustafsson, Bremberg & Mobjörk, 2018). The UNDP facilitates resilience for small businesses by involving stakeholders in developing investment projects that overcome the underlying resilience barriers. These can be technological, financial, socio-cultural and institutional obstacles. Substantial climate change from rising sea standards and severe weather conditions to long-term significant drought and flooding is confronting vulnerable populations. Under the World Bank, changing climate could throw more than 100 million people into poverty by 2030 without effective mitigation initiatives.

Muriithi (2017) assessed that in developing economies, SMEs contribute up to 45% of jobs and 33% of the GDP and when informal SMEs are included, those figures are considerably higher. When a small business builds its own climate resilience, the environment around it can have a cascading impact. Regrettably, in general SME owners have difficulties in securing bank loans, instead of turning their businesses to informal lending and alternative finance sources. According to The World Bank (2018), there is no structured credit available to 50% of formal SMEs and a global credit deficit of up to \$2.6 trillion for formal and informal SMEs. The difference is substantially different between countries, but in Africa and Asia in particular. This gap can be closed by micro-finance through providing micro-finance services for SMEs. Increased definition must be given to the role of micro-finance in strengthening SMEs' resilience to climate change. Micro-finance has helped SMEs in Africa, Asia and Latin America

to spend on droughts, improve better irrigation systems and obtain income-protecting climate insurance if crops fail due to too much or too little rainfall (Chirambo, 2017).

In 2010, 43% of Bangladeshi micro-finance activities strengthened community resilience, according to the Organisation for Economic Co-operation and Development (OECD) report. This includes weather-resistant housing loan schemes, drought and salt tolerant crops and enhanced climate change resilience. Micro-finance in Nepal supports disaster relief, preparedness, diversification of crops, and expanded access to irrigation (Roy, 2018). Furthermore, micro-finance could allow SMEs to move to low carbon business models by funding their efforts to adopt renewable sources of energy and transition into sustainable production and supply chains (Roy, 2018).

It definitely has its criticism that micro-finance is not the only solution towards assisting SMEs from impacts of climate change (Chirambo, 2017). Financial institutions should reward SME owners who use loans to finance climate change resilience projects and renewable energy projects to allay concerns about underspent money. This need not be an act of corporate social responsibility (Ibrahim, 2020). According to the Commission on Business and Sustainable Development (2018), such an approach is in the interests of micro-finance institutions themselves. If the world is serious about alleviating the worst effects of climate change, in particular its disproportionate impact on vulnerable communities, efforts to extend micro-finance to SMEs should be supported by both the public and private sectors. Those on the front line of protecting lives and livelihoods cannot go on their own (Barrett, Feola, Khusnitdinova & Krylova, 2017).

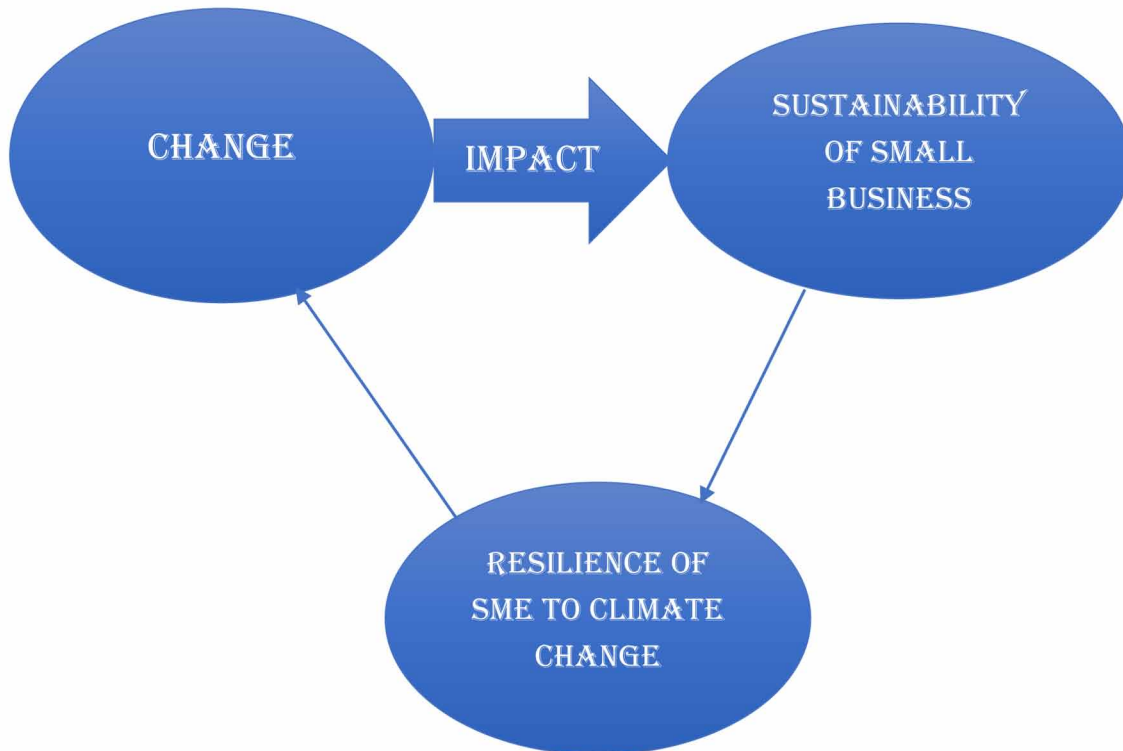
Goldstein, Turner, Gladstone and Hole (2019) opined that SMEs are frequently perceived as elements of economic growth, and the consequences of climate change present a major challenge to the private sector. If climate variability and extreme weather events threaten their viability, then the whole economy will suffer (Dube & Nhamo, 2020). Consequently, loss of jobs and decreasing economic growth are potential effects of climate change. It can have a direct effect on companies such as damage to the buildings or sites or interruption of the manufacturing process, if equipment or workers, for example, are overheated too often. The need to respond to climate change could simultaneously establish a new production of goods and services and speed up new market opportunities (Chirambo, 2017).

Response of SMEs to Climate Change Risk in Africa

SMEs provide an advantage to an emerging country's economic growth (Muriithi, 2017). SMEs often want to figure out how to survive because they lack alternatives, but that may not be the case in small and medium-sized companies in innovative industries that seek creativity instead of mere survival (Dube & Nhamo, 2020). These companies face heavy competition as well as sudden pace that involve innovation and creativity. These aspects will enable them to find ways of innovating proactively (Nikolaou, Nikolaidou & Tsagarakis, 2016). According to Conway et al. (2019), adaptation to climate change can be accomplished by business continuity or risk management strategies for a SME or a business in general.

In confirmation of this is Ali, Nagalingam and Gurd (2017) who recorded that while the implementation of those policies was also found to be minimal, SMEs seem to concentrate more on overall business continuity or risk management strategies. This level of adoption among SMEs with previous experience with the risks associated with floods was generally higher, and those businesses would be more likely than small and medium-sized companies without this experience to implement property-level protection measures. Property insurance, the implementation of a business data backup plan and business disruption insurance are commonly used by small and medium-size business continuity programmes.

Figure 1. Conceptual framework of SMEs' resilience in Africa
Source: Authors (2021)



Fear of SME on the Impact of Climate Change on Their Business

Climate change is such a broad issue, and it is affecting business in a wide variety of ways (Wittneben & Kiyar, 2009). Hence, climate change is a serious challenge of SMEs. These severe weather events have the ability to interrupt supply chains, making it more difficult for companies to access materials and resources. Drought conditions and changes in weather patterns could affect the availability of crops used for food, clothing and other items. Increased electricity and transport costs can also raise the cost of transporting goods. Regulatory constraints on products related to climate change can also raise prices (Iizumi & Ramankutty, 2015). Ghaffar, Burman and Braimah (2020) observed that scarcity of resources could force businesses to use different methods and recycle further waste. These impacts will also have an exponential effect as the failure to or delay in providing a resource due to its availability or due to infrastructure damage may have a knock-on effect for a number of businesses.

The intrinsic environment includes factors that are typically manageable by the business community in the business environment. Business environment problems include management experience and abilities, poor financial awareness and lack of business management preparation and technological skills (Sehgal, 2010). Reser and Bradley (2017) observed that current business practices in sectors like farming, manufacturing, banking, infrastructure, insurance, development and trade are already under pressure due to the imminent effects of chronic climate threats. There is widespread concern in the agricultural sector that threatens the physical environment and the availability of key commodities such as cocoa, rice, fish

and tea, and claims on the insurance industry, such as storm and heat wave fires, are growing because of the impacts of extreme weather events.

Such impacts are more profound in the poorest and most vulnerable areas, even though their physical climatic threats impact businesses globally. According to the Zurich Report (2016): 4 out of 5 SMEs fear the effect on their enterprises of climate change. More than a third (36%) of SMEs considered material harm as the most significant business concern due to climate change. A danger of business interruptions (26%) was thought to be the next greatest risk due to climate change. Additional threats related to climate change included interruptions of the supply chain, higher energy and water prices theoretically and the effect of severe climate change on the health of the workers (Zurich Report, 2016).

Sustainability Imperative for Small Business Climate Change

The health and stability of the global economy rely on SMEs as they account for over 95% of all enterprises and account for the majority of the GDP of the private sector, income and employment growth and social and environmental impacts (Baranova & Paterson, 2017; World Bank, 2018). Because most of the population in the developing world relies on the survival of micro and small enterprises, this segment of the economy must be more resilient to potential climatic effects. At the same time, they are well positioned to develop products and services that strengthen the resilience of vulnerable communities and to market them (Chaturvedi & Doyle, 2010; Lincoln Lenderking, Robinson & Carlson, 2020). In the meantime, the natural world is under tremendous pressure and there is recognition of the rapid depletion of scarce resources. Today, the environmental impact of SMEs remains under constant pressure to measure and track (Amrinder, 2016). They are part of the supply chain, with growing demand for sustainable management by customers and suppliers, particularly those SMEs that seek to secure contracts with governments or large corporations. SMEs must also ensure they have access to future tools to continue supplying their products and services (Nidumolu, Ellison, Whalen & Billman, 2014).

From a macro perspective, the SME category of companies is essential to sustainable growth. Although smaller and environmentally sustainable specific SMEs are naturally less important than big businesses, in many countries SMEs dominate the business arena (Westman, Luederitz, Kundurpi, Mercado, Weber & Burch, 2019). It is very natural that the entire SME community has a significant environmental effect as a result of this predominance. Lin and Agyeman (2020) suggested that although it is difficult to measure the precise amount of environmental damage that SMEs are experiencing, estimates between 60% and 70% of overall emission levels have been recorded in various studies. Despite their value, it has often been argued that SMEs are lagging behind when it comes to commitment to sustainability. Several factors, mostly focused on the particular characteristics of SMEs, have been raised in the literature to explain this phenomenon.

Effect of Climate Change on Financial Performance of SMEs

Financial performance is seen as a symbol of the overall financial position as well as health of the business entity over a given financial year, i.e. the ability to simplify its assets, equity and intangible value (Lucato, Costa & de Oliveira Neto, 2017). In the meantime, the success of climate change means more efficient and stable corporate level management. This is the product of a robust management strategy for the implementation of climate change initiatives, but not at the detriment of achieving targets and long-term cost-effectiveness (Agan, Acar & Borodin, 2013). In addition, the adoption of climate change

policies strengthens organisational integrity, corporate reputation of the company and employee obligations in organisations (Sáez-Martínez, Díaz-García & González-Moreno, 2016). Not to mention, this culminates in the organisation's burgeoning organisational creativity and operational performance, thereby enhancing the organisation's corporate competitiveness. The optimistic nexus among environmental and social performance and organisational financial performance still maintains a dominant lead amid the proliferation of dichotomous empirical evidence in the last two decades (Wilhelm, 2013).

The frequency and severity of severe weather events are rising with climate change and are expected to have significant effects on the African economy and financial system (Collier, Conway & Venables, 2008). These risks of climate change, in both direct and indirect channels, impact financial performance. The direct effect of climate change risks on financial results is the change in the natural conditions of production and activity of businesses, including properties, raw materials, manufacturing techniques, support systems, and so on (Dafermos, Nikolaidi & Galanis, 2018). There is an indication that the synergy between environmental and financial performance is stronger in times of economic recession, which means that businesses need to continue investing in sustainable initiatives in order to maintain ties with their stakeholders, resulting in higher economic profits (Alexopoulos, Kounetas & Tzelepis, 2018).

Recent studies have focused attention on the correlation between sustainability and economic return. For example, the following observations were made by Soyka (2012), Secinaro, Brescia, Calandra and Saiti (2020) and Cadez and Guilding (2017): Return on assets, return on sales and return on equity metrics were found to improve for companies that have substantially reduced pollutant emissions, there is a favourable relation between low emissions and a high net margin and capital cost increases. The relation among low emissions and high net margins is strong, for companies focused on environmental, corporate governance activities. Equity capital costs are lower and have been shown by positive beta (less share price volatility) and improved cash flows. Debt capital costs are usually a premium for entities with environmental vulnerabilities and bond ratings are generally higher.

CONCLUSION AND RECOMMENDATIONS

Climate change is rapidly becoming the most urgent problem facing humanity in the 21st century. Despite rapid efforts in the mitigation of climate change, there are rising global impacts on climate change. The impacts of climate change on economic growth, social advancement and environmental sustainability will in the future be exponential and catastrophic. Undoubtedly, climate change will have a drastic effect on the economy and culture of Africa and there is an immediate need to adapt to climate change. African countries embark on a reasonable transition to a low-carbon, climate-resistant and environmentally sustainable economy, there is a chance to build small green domestic companies. SMEs need to recognise the changing market and business landscape and also be clearly identified as a responsible supplier and employer. This would mean demonstrating their commitment to being more sustainable in order to be responsible for the earth in the first place, but also to compete effectively on tenders, to cater to new, eco-friendlier workers and customers and to access funding and business support. For small business to be able to meet the global sustainability target amidst climate change, there would be the need to have greater support from financial institutions, insurance companies and international government support through COP21.

REFERENCES

- Abisuga-Oyekunle, O. A., Patra, S. K., & Muchie, M. (2020). SMEs in sustainable development: Their role in poverty reduction and employment generation in sub-Saharan Africa. *African Journal of Science, Technology, Innovation and Development*, 12(4), 405–419. doi:10.1080/20421338.2019.1656428
- Adam, I. O., & Musah, A. (2015). Small and medium enterprises (SMEs) in the cloud in developing countries: A synthesis of the literature and future research directions. *Journal of Management and Sustainability*, 5(1), 115. doi:10.5539/jms.v5n1p115
- Adisa, T. A., Abdulraheem, I., & Mordi, C. (2014). The Characteristics and Challenges of Small Businesses in Africa: An Exploratory Study of Nigerian Small Business Owners. *Petroleum-Gas University of Ploiesti Bulletin. Technical Series*, 66(4), 1–14.
- Agan, Y., Acar, M. F., & Borodin, A. (2013). Drivers of environmental processes and their impact on performance: A study of Turkish SMEs. *Journal of Cleaner Production*, 51, 23–33. doi:10.1016/j.jclepro.2012.12.043
- Alexopoulos, I., Kounetas, K., & Tzelepis, D. (2018). Environmental and financial performance. Is there a win-win or a win-loss situation? Evidence from the Greek manufacturing. *Journal of Cleaner Production*, 197, 1275–1283. doi:10.1016/j.jclepro.2018.06.302
- Ali, I., Nagalingam, S., & Gurd, B. (2017). Building resilience in SMEs of perishable product supply chains: Enablers, barriers and risks. *Production Planning and Control*, 28(15), 1236–1250. doi:10.1080/09537287.2017.1362487
- Amrinder, P. C. S. (2016). A Study of Small and Medium Enterprises (SME) in India on Sustainability Strategy: Highlighting Critical Challenges and Constraints. *Journal of Asia Entrepreneurship and Sustainability*, 12(2), 49.
- Banwo, A. O., Du, J., & Onokala, U. (2017). The determinants of location specific choice: Small and medium-sized enterprises in developing countries. *Journal of Global Entrepreneurship Research*, 7(1), 1–17. doi:10.1186/40497-017-0074-2
- Baranova, P., & Paterson, F. (2017). Environmental capabilities of small and medium sized enterprises: Towards transition to a low carbon economy in the East Midlands. *Local Economy*, 32(8), 835–853. doi:10.1177/0269094217744494
- Barrett, T., Feola, G., Khusnitdinova, M., & Krylova, V. (2017). Adapting agricultural water use to climate change in a post-Soviet context: Challenges and opportunities in Southeast Kazakhstan. *Human Ecology*, 45(6), 747–762. doi:10.1007/10745-017-9947-9 PMID:29213176
- Bhattacharyya, P., & Barman, D. (2018). Crop residue management and greenhouse gases emissions in tropical rice lands. In *Soil management and climate change* (pp. 323–335). Academic Press. doi:10.1016/B978-0-12-812128-3.00021-5
- Bibri, S. E., & Krogstie, J. (2017). Smart sustainable cities of the future: An extensive interdisciplinary literature review. *Sustainable Cities and Society*, 31, 183–212. doi:10.1016/j.scs.2017.02.016

- Biggeri, M., Anand, P. B., Fennell, S., & Comim, F. (2020 forthcoming). *Small and medium enterprises and industrial clusters in BRICS countries*. In *Handbook of BRICS and emerging economies*. Oxford University Press.
- Bruno, J. F., Bates, A. E., Cacciapaglia, C., Pike, E. P., Amstrup, S. C., Van Hooidek, R., Henson, S. A., & Aronson, R. B. (2018). Climate change threatens the world's marine protected areas. *Nature Climate Change*, 8(6), 499–503. doi:10.1038/41558-018-0149-2
- Bui, B., & De Villiers, C. (2017). Business strategies and management accounting in response to climate change risk exposure and regulatory uncertainty. *The British Accounting Review*, 49(1), 4–24. doi:10.1016/j.bar.2016.10.006
- Cadez, S., & Guilding, C. (2017). Examining distinct carbon cost structures and climate change abatement strategies in CO2 polluting firms. *Accounting, Auditing & Accountability Journal*, 30(5), 1041–1064. doi:10.1108/AAAJ-03-2015-2009
- Chirambo, D. (2017). Enhancing climate change resilience through microfinance: Redefining the climate finance paradigm to promote inclusive growth in Africa. *Journal of Developing Societies*, 33(1), 150–173. doi:10.1177/0169796X17692474
- Chirambo, D. (2018). Towards the achievement of SDG 7 in sub-Saharan Africa: Creating synergies between Power Africa, Sustainable Energy for All and climate finance in-order to achieve universal energy access before 2030. *Renewable & Sustainable Energy Reviews*, 94, 600–608. doi:10.1016/j.rser.2018.06.025
- Collier, P., Conway, G., & Venables, T. (2008). Climate change and Africa. *Oxford Review of Economic Policy*, 24(2), 337–353. doi:10.1093/oxrep/grn019
- Cramer, C., Sender, J., & Oqubay, A. (2020). *African economic development: Evidence, theory, policy*. Oxford University Press. doi:10.1093/oso/9780198832331.001.0001
- Dafermos, Y., Nikolaidi, M., & Galanis, G. (2018). Climate change, financial stability and monetary policy. *Ecological Economics*, 152, 219–234. doi:10.1016/j.ecolecon.2018.05.011
- Deen-Swaray, M., Moyo, M., & Stork, C. (2013). ICT access and usage among informal businesses in Africa. *Info*, 15(5), 52–68. doi:10.1108/info-05-2013-0025
- Dellmuth, L. M., Gustafsson, M. T., Bremberg, N., & Mobjörk, M. (2018). Intergovernmental organizations and climate security: Advancing the research agenda. *Wiley Interdisciplinary Reviews: Climate Change*, 9(1), e496. doi:10.1002/wcc.496
- Doyle, T., & Chaturvedi, S. (2010). Climate territories: A global soul for the global south? *Geopolitics*, 15(3), 516–535. doi:10.1080/14650040903501054
- Dube, K., & Nhamo, G. (2020). Vulnerability of nature-based tourism to climate variability and change: Case of Kariba resort town, Zimbabwe. *Journal of Outdoor Recreation and Tourism*, 29, 100281. doi:10.1016/j.jort.2020.100281
- Edwards, D. (1998). *The link between company environmental and financial performance*. Earthscan.

Climate Change and the Sustainability of Small Businesses in Africa

Galbreath, J., Charles, D., & Oczkowski, E. (2016). The drivers of climate change innovations: Evidence from the Australian wine industry. *Journal of Business Ethics*, *135*(2), 217–231. doi:10.1007/10551-014-2461-8

Gbandi, E. C., & Amissah, G. (2014). Financing options for small and medium enterprises (SMEs) in Nigeria. *European Scientific Journal*, *10*(1), 326–340.

Ghaffar, S. H., Burman, M., & Braimah, N. (2020). Pathways to circular construction: An integrated management of construction and demolition waste for resource recovery. *Journal of Cleaner Production*, *244*, 118710. doi:10.1016/j.jclepro.2019.118710

Goldstein, A., Turner, W. R., Gladstone, J., & Hole, D. G. (2019). The private sector's climate change risk and adaptation blind spots. *Nature Climate Change*, *9*(1), 18–25. doi:10.1038/41558-018-0340-5

Hallegatte, S., & Brian Walsh, B. (2020). COVID, climate change and poverty: Avoiding the worst impacts. *World Bank Group*. <https://blogs.worldbank.org/climatechange/covid-climate-change-and-poverty-avoiding-worst-impacts>

Hempson, G. P., Archibald, S., & Bond, W. J. (2017). The consequences of replacing wildlife with livestock in Africa. *Scientific Reports*, *7*(1), 1–10. doi:10.1038/41598-017-17348-4 PMID:29222494

Hervé, A., Schmitt, C., & Baldegger, R. (2020). Digitalization, Entrepreneurial Orientation and Internationalization of Micro-, Small-and Medium-Sized Enterprises. *Technology Innovation Management Review*, *10*(4), 5–17. doi:10.22215/timreview/1343

Hoogendoorn, G., & Fitchett, J. M. (2018). Tourism and climate change: A review of threats and adaptation strategies for Africa. *Current Issues in Tourism*, *21*(7), 742–759. doi:10.1080/13683500.2016.1188893

Izumi, T., & Ramankutty, N. (2015). How do weather and climate influence cropping area and intensity? *Global Food Security*, *4*, 46–50. doi:10.1016/j.gfs.2014.11.003

Ju, X., Ferreira, F. A., & Wang, M. (2020). Innovation, agile project management and firm performance in a public sector-dominated economy: Empirical evidence from high-tech small and medium-sized enterprises in China. *Socio-Economic Planning Sciences*, *72*, 100779. doi:10.1016/j.seps.2019.100779

Kais, S. M., & Islam, M. S. (2016). Community capitals as community resilience to climate change: Conceptual connections. *International Journal of Environmental Research and Public Health*, *13*(12), 1–16. doi:10.3390/ijerph13121211 PMID:27929448

Katz, J. A., & Green, R. P. (2018). *Entrepreneurial small business*. McGraw-Hill Education.

Leboea, S. T. (2017). *The factors influencing SME failure in South Africa* (Master's thesis). University of Cape Town.

Lee, S. Y., & Klassen, R. D. (2016). Firms' response to climate change: The interplay of business uncertainty and organizational capabilities. *Business Strategy and the Environment*, *25*(8), 577–592. doi:10.1002/bse.1890

Libell, J. P. (2018). *Exploring Strategies and Sustainability of Small Business Owners in Bethel Park Pennsylvania* (Doctoral dissertation). Colorado Technical University.

- Lin, B., & Agyeman, S. D. (2020). Assessing Sub-Saharan Africa's low carbon development through the dynamics of energy-related carbon dioxide emissions. *Journal of Cleaner Production*, 274, 122676. doi:10.1016/j.jclepro.2020.122676
- Lincoln Lenderking, H., Robinson, S. A., & Carlson, G. (2020). Climate change and food security in Caribbean small island developing states: Challenges and strategies. *International Journal of Sustainable Development and World Ecology*, 1–8. doi:10.1080/13504509.2020.1804477
- Lucato, W. C., Costa, E. M., & de Oliveira Neto, G. C. (2017). The environmental performance of SMEs in the Brazilian textile industry and the relationship with their financial performance. *Journal of Environmental Management*, 203, 550–556. doi:10.1016/j.jenvman.2017.06.028 PMID:28647218
- Maduku, D. K., Mpinganjira, M., & Duh, H. (2016). Understanding mobile marketing adoption intention by South African SMEs: A multi-perspective framework. *International Journal of Information Management*, 36(5), 711–723. doi:10.1016/j.ijinfomgt.2016.04.018
- Mamabolo, M. A., Kerrin, M., & Kele, T. (2017). Entrepreneurship management skills requirements in an emerging economy: A South African outlook. *Southern African Journal of Entrepreneurship and Small Business Management*, 9(1), a111. doi:10.4102ajesbm.v9i1.111
- Mathu, K., & Tlare, M. T. (2017). The impact of IT adoption in SMEs supply chains: A case of Gauteng and Free State provinces of South Africa. *South African Journal of Business Management*, 48(3), 63–71. doi:10.4102ajbm.v48i3.36
- Misati, E., Walumbwa, F. O., Lahiri, S., & Kundu, S. K. (2017). The internationalization of African small and medium enterprises (SMEs): A South-North pattern. *Africa Journal of Management*, 3(1), 53–81. doi:10.1080/23322373.2016.1275940
- Montmasson-Clair, G., Mudombi, S., & Patel, M. (2019). Small business development in the climate change adaptation space in South Africa. *TIPS and Government of Flanders*. <https://www.tips.org.za/research-archive/sustainable-growth/green-economy-2/item/3621-small-business-development-in-the-climate-change-adaptation-space-in-south-africa>
- Muriithi, S. (2017). African small and medium enterprises (SMEs) contributions, challenges and solutions. *European Journal of Research and Reflection in Management Sciences*, 5(1), 36–48.
- Ngin, C., Chhom, C., & Neef, A. (2020). Climate change impacts and disaster resilience among micro businesses in the tourism and hospitality sector: The case of Kratie, Cambodia. *Environmental Research*, 186, 109557. doi:10.1016/j.envres.2020.109557 PMID:32334166
- Nidumolu, R., Ellison, J., Whalen, J., & Billman, E. (2014). The collaboration imperative. *Harvard Business Review*, 92(4), 76–84. PMID:24830283
- Nikolaou, I. E., Nikolaidou, M. K., & Tsagarakis, K. P. (2016). The response of small and medium-sized enterprises to potential water risks: An eco-cluster approach. *Journal of Cleaner Production*, 112, 4550–4557. doi:10.1016/j.jclepro.2015.09.068
- Nyamrunda, F., & Freeman, S. (2021). Small and Medium Enterprises in Transitional East African Economies: The Case of Tanzania. In *Doing Business in Africa* (pp. 277-307). Palgrave Macmillan.

Climate Change and the Sustainability of Small Businesses in Africa

Oo, H. T., Zin, W. W., & Kyi, C. C. T. (2019). Assessment of future climate change projections using multiple global climate models. *Civil Engineering Journal*, 5(10), 2152–2166. doi:10.28991/cej-2019-03091401

Reser, J. P., & Bradley, G. L. (2017). Fear appeals in climate change communication. In Oxford research encyclopedia of climate science. doi:10.1093/acrefore/9780190228620.013.386

Roy, R. (2018). Evaluating the suitability of community-based adaptation: a case study of Bangladesh. In *Handbook of Climate Change Communication* (Vol. 1, pp. 39–59). Springer. doi:10.1007/978-3-319-69838-0_3

Saah, P. (2019). *A framework to enhance the sustainability of Small and Medium Size Enterprises in selected municipalities of the North West Province of South Africa* (Doctoral dissertation). North-West University, South Africa.

Sáez-Martínez, F. J., Díaz-García, C., & González-Moreno, Á. (2016). Factors promoting environmental responsibility in European SMEs: The effect on performance. *Sustainability*, 8(9), 898. doi:10.3390/s8090898

Salisu, Y., & Abu Bakar, L. J. (2019). Technological capability, relational capability and firms' performance: The role of learning capability. *Revista de Gestão*, 27(1), 79–99. doi:10.1108/REGE-03-2019-0040

Secinaro, S., Brescia, V., Calandra, D., & Saiti, B. (2020). Impact of climate change mitigation policies on corporate financial performance: Evidence-based on European publicly listed firms. *Corporate Social Responsibility and Environmental Management*, 27(6), 2491–2501. doi:10.1002/csr.1971

Sehgal, R. N. M. (2010). Deforestation and avian infectious diseases. *The Journal of Experimental Biology*, 213(6), 955–960. doi:10.1242/jeb.037663 PMID:20190120

Soyka, P. A. (2012). *Creating a sustainable organization: Approaches for enhancing corporate value through sustainability*. FT Press.

Swart, R., Robinson, J., & Cohen, S. (2003). Climate change and sustainable development: expanding the options. *Climate Policy*, 3(sup1), S19-S40.

Welsh, D. H. (2016). Women-owned family businesses in Africa: Entrepreneurs changing the face of progress. In *Family Businesses in Sub-Saharan Africa* (pp. 155–173). Palgrave Macmillan. doi:10.1057/978-1-137-36143-1_6

Westman, L., Luederitz, C., Kundurpi, A., Mercado, A. J., Weber, O., & Burch, S. L. (2019). Conceptualizing businesses as social actors: A framework for understanding sustainability actions in small-and medium-sized enterprises. *Business Strategy and the Environment*, 28(2), 388–402. doi:10.1002/bse.2256

Wilhelm, K. (2013). *Return on sustainability: how business can increase profitability and address climate change in an uncertain economy*. FT Press.

Wittneben, B. B. F., & Kiyar, D. (2009). Climate change basics for managers. *Management Decision*, 47(7), 1122–1132. doi:10.1108/00251740910978331

Wright, C., & Nyberg, D. (2017). An inconvenient truth: How organizations translate climate change into business as usual. *Academy of Management Journal*, 60(5), 1633–1661. doi:10.5465/amj.2015.0718

Climate Change and the Sustainability of Small Businesses in Africa

Zhang, K., Su, J., Xu, M., Zhou, Z., Zhu, X., Ma, X., Hou, J., Tan, L., Zhu, Z., Cai, H., Liu, F., Sun, H., Gu, P., Li, C., Liang, Y., Zhao, W., Sun, C., & Fu, Y. (2020). A common wild rice-derived BOC1 allele reduces callus browning in indica rice transformation. *Nature Communications*, *11*(1), 1–15. doi:10.1038/41467-019-14265-0 PMID:31974373

Zurich. (2016). *Four out of five SMEs fear impact of climate change on their business*. Zurich Insurance Group. <https://www.zurich.com/en/media/news-releases/2016/2016-1103-01>

Chapter 16

Sustainability Tourism and Socio–Economic Development

Cigdem Unurlu

 <https://orcid.org/0000-0001-5653-6013>

Trakya University, Turkey

ABSTRACT

The main purpose of this study is to assess sustainable tourism theoretically and practically in a systematic point of view and to provide guidance for future plans and policies related to sustainable tourism. In accordance with this purpose, firstly, the concepts of sustainability, sustainable tourism, and socio-economic development have been discussed, and secondly, the purpose, the principles, and the tools of sustainable tourism were evaluated. Within the scope of sustainable tourism, carrying capacity, environmental impact assessment, and ecological footprint phenomenon were examined.

INTRODUCTION

All the ecological-cultural-social and environmental values of the world, in which we live today, are a common heritage of the whole humanity. It is a common responsibility of the whole humanity to improve and transfer this heritage. With the industrial revolution, our world has dealt with some serious environmental and climate challenges. Even though this situation may seem highly dreadful, it is possible to reverse these negative tendencies and trends (Bruyninckx, 2019). Since our economies depend on fossil fuels and land cultivation practices, the greenhouse gas concentration in the atmosphere increases; and this harms both the climate and the environment, which makes it difficult to pass these values on to the future generations. Our current economies have destroyed habitats and have caused many species to become extinct. Hence, the diversity in life has been lost at an unsustainable rate. Studies have shown that our economies are not sustainable (Kılıç, 2012). Our production models generate high amounts of waste. As a result, the ecology and the environment are damaged in an irreversible way. Moreover, the benefits of economic growth are unfortunately not shared equally all around the world. Even in Europe, where the living standards are considerably above the average, there are communities living below the poverty threshold. Climate and environmental change affect these communities the most. As long as these

DOI: 10.4018/978-1-7998-7967-1.ch016

current trends continue, the future generations will have to experience challenging tests regarding the climate and the environment (Bruyninckx, 2019). On the other hand, sustainability is an environmental reaction to the production models which cause extremely negative effects on the environment, climate and society. From this point of view, sustainable tourism is an approach which serves sustainable development and gives importance to ecology, environment and society. In this respect, sustainable tourism enables us to gain significant ecosystems back, minimise the negative effects and protect the ecological-environmental values we have in a powerful way. In sustainability understanding of tourism; economy, climate, environment and society are inseparable parts of a whole. In this understanding, ecology is not regarded as an element of economy. However, economy is a part of ecology and the sustainability of values which constitute a resource for tourism is the most crucial issue.

Tourism has an increasingly important effect on socio-economic development. The direct, indirect and induced impact of tourism is 8.9 trillion dollars for global GDP (Gross Domestic Product) in 2019 (Wttc, 2020). According to Yu (2012), tourism is an economic pillar which triggers greater impacts on GDP. The benefits of tourism should be shared among a wide range of stakeholders (tourists, residents, tourism businesses, culture, ecology etc.) (Heslinga et al., 2019). Thanks to the interconnectedness of tourism with other industries, everyone benefits from tourism (Yu, 2012). According to 2030 Roadmap of United Nations World Tourism Organization (UNWTO), partnerships amongst the stakeholders should be strengthened and collaborations should be enhanced since sustainable tourism requires transparent - clear actions, monitoring appropriate communication tools and liability to the society. According to World Tourism Organization and United Nation Environment Programme, sustainable tourism is a kind of tourism, which fulfills the needs of tourists, visitors, residents, the environment and the industry by considering all of its available and future economic-social-environmental impacts. In the sustainability approach, which is characterized as the future of the industry, it is also possible to consider sustainable tourism as a nature-based tourism, ecotourism or rural tourism (Pan, et. al., 2018). Sustainable tourism is a paradigm in which environment, biological diversity, ecological processes and cultural integrity are preserved without degradation. In this approach, it is expected to minimise the negative impacts of tourism on environment and community while it is also expected to preserve cultural heritage and natural environment by enhancing the quality of life in the destination through an interaction of tourists and the local people. Sustainable tourism, which intends to protect biodiversity, ecological processes and environmental values, is a responsible tourism understanding. In this tourism understanding, it is aimed to contribute to the local economy by minimising the negative effects of tourism on environment and society, and to improve the quality of life of local people and visitors. Tourism is a significant development tool particularly for developing countries. Developing countries regard tourism as an economic policy tool and try to overcome economic difficulties with the help of tourism. Even though tourism is regarded as an economic development tool, it also has several negative impacts on the socio-cultural environment. It is possible to destroy ecological and environmental resources in an irreversible way and by this way it is impossible to make these resources pass on to the future generations. Therefore, countries have started to adopt sustainable tourism policies in order to be able to transfer the current ecological and environmental values to the future generations and to ensure the permanency of the impact of tourism on development. Thanks to the widespread conscious use of ecological, social and cultural values, it has been possible to reduce the negative impacts of tourism on the environment. On the other hand, sustainable tourism is seen as an element of balance in terms of providing the local residents with social advantage and protecting the environmental values. Accordingly, sustainable tourism is considered as an extension of sustainable development. One of the basic principles of sustainable tourism is to bring in

ecological and environmental values, which constitute the sources of tourism by taking protection-use balance into account (Alkan, 2015). From this point of view, sustainable tourism represents an understanding which ensures the protection and the transfer of ecological-cultural-social and environmental values to the future generations by developing these values. Besides contributing to the local economy, sustainable tourism also improves the quality of life of local residents. Furthermore, it encourages the local people to be proud of the customs and socio-cultural values they have and it also aims to protect the cultural identity as well as improving this identity for the future generations. In this respect, sustainable tourism is a responsible tourism understanding, which constantly keeps the balance of the advantages obtained from tourism and the costs caused by tourism under control and considers the protection-use balance that constitute the sources of ecological and environmental values of tourism (Erkara, 2019). To sum up, the main purpose of this study is to assess sustainable tourism conceptually in a systematic way and to guide the future plans and the policies related to tourism. In accordance with this purpose, firstly, the concept of sustainable tourism had been examined, and then the purpose, the principles and the tools of sustainable tourism were evaluated. Within the scope of the tools of sustainable tourism, carrying capacity, environmental impact assessment and ecological footprint phenomenon were examined.

SUSTAINABILITY APPROACH

To be able to survive, humans and organisms need a healthy ecosystem and environment. The term of sustainability should be evaluated as equilibrium between human and ecosystem. Even though the use of sustainability is extensive, there is not a precise definition of sustainability. However, the aptitude to subsist perpetually is called “sustainability”. This concept means that the biosphere and human civilization have the ability to live together. It also refers the preservation of current resources to meet the potential future needs of human beings. Sustainability is a social and an ecological process in which exists a balance between species and resources. This process requires a socio-ecological resource management; sustaining balance in social and ecological environment and it requires current resources not to be consumed quicker than naturally generated (Wikipedia, 2020). Çakılcıoğlu (2002) defines sustainability as the ability of a society, ecosystem or any system with permanency to carry out its activities without an interruption or a disruption. In order to be able to maintain this ability, the main resources, which have a vital link for the system, ought not to be used beyond their carrying capacity (Çakılcıoğlu, 2002). The sustainability approach is a multi-dimensional approach and it involves social, cultural, political and environmental processes. Economy is regarded as an element of ecological environment in this approach. Thus, economy is considered on the basis of ecology. In the classical production approach, there is a devastating use of natural resources in order to meet unlimited human needs. However, in the sustainability approach, there is a production understanding with limited production within the ecosystem and environmental values are protected. Sustainability expresses a compromise, which defines the balance between economy and ecology. Not only the ecological and economic processes, but also the socio-cultural values and the quality of life of the society need to be taken into consideration in this compromise. The fundamental principles of this approach include (1) reducing poverty, (2) providing equal opportunities to access resources, (3) ensuring the fair distribution of resources, (4) passing the historical and cultural heritage on to the future generations and (5) looking at the future with confidence (Doğan, 2010). On the other hand, “sustainability development” was used in the Brundtland Report for the first time. According to this report, sustainability development is a period in which the utilization

of resources, the orientation of investments and the technological development are made consistent with present and future needs (World Commission on Environment and Development, 1987, 90). Even though there are a great number of opinions on sustainable development, there is still not a definition, upon which everyone agrees (Balyev, 2018). Nevertheless, according to Brutland Report (United Nations, 1987), the main characteristics of sustainable development are stated below (Niedziolka, 2014):

- Sustainable development adopts a holistic approach,
- The protection of bio diversity and cultural heritage is essential,
- Basic ecological processes are preserved and administrated,
- It requires the local residents to get involved in the process,
- It aims at preserving the resources and transferring them to the future generations,
- It provides international justice and equal opportunities.

Sustainable development has gained significance when it was realized that the uncontrolled economic growth posed an environmental threat. This situation indicates the importance of sustainable tourism, which is considered as a complementary part of sustainable development (Stabler & Goodall, 1997).

SUSTAINABLE TOURISM

Tourism is a phenomenon based on environment. Historical, social, natural and cultural attractions are among the most notable attractions of tourism. Preserving these attractions and passing them on to the future generations are in question in sustainable tourism approach. According to the sustainable tourism understanding, the quality of tourism services is not only assessed from the perspective of tourists. In this assessment, the gains of different interest groups (local people, ecology, environment, historical-cultural elements) are also taken into consideration. From this point of view, the tourism approach, which gives importance to the satisfaction of tourists only, has been examined. Instead of this approach, a versatile and broadly based approach, which takes the gains of other interest groups into consideration has been adopted (Doğan, 2010). Several studies indicate that environment will be the element which is going to affect the demand in tourism the most in 21st century (Crouch & Ritchie, 1999). Therefore, the significance of sustainable tourism is pointed out in this assessment. The preservation of natural, cultural and historical values which represent the source of tourism is the most crucial criterion in the sustainability of tourism. Weaver and Lawton (1999) have proposed an implicit debate about the necessity of sustainable tourism since the 1950s and stated that the current tourism is not sustainable. In addition to this, they also claimed that sustainable tourism passed through a variety of phases until the 1990s when the term of sustainability became a supreme approach. On the other hand, there are different perspectives and understandings about sustainable tourism approach. These different perspectives and understandings harm the essence of sustainability approach and cause confusion in sustainable tourism practices (McDonald, 2006). There are some of positive and negative effects of tourism in terms of economic, socio-cultural and environmental aspects in Table 1.

Sustainability Tourism and Socio-Economic Development

Table 1. Positive and negative effects of tourism (Oli & Chhetri, 2015; Lickorish & Jenkins 1997)

Effects	Economic	Socio-cultural	Environmental
Positive	Workforce opportunities, the rise of income, foreign currency income, the development of infrastructure	The protection of socio-cultural heritage, the contribution to international peace, the preservation of natural areas	The protection of natural environment
Negative	Uneven distribution of tourism incomes, seasonal unemployment, the rate of low capacity usage, inflationary pressure, lack of facilities, smuggling, problems in terms of land-use, improper disposal of waste	The decrease in the effects of socio-cultural heritage, the damage to historical and cultural values, congestion	Vandalism, pollution, the increase of population, carbon emission, water contamination, air pollution damage to the wild-life, soil erosion

On the one hand, Yılmaz (2007) categorized the effects of tourism as socio-economic and socio-cultural by studying both positive and negative impacts in this categorization. For instance, employment opportunities offered by tourism, providing re-distribution of incomes and hence preventing poverty take place in the socio-economic effects of tourism. Besides, tourism has positive effects such as contributing to social development, promoting the development of infrastructure and superstructure, supporting small-sized and medium-sized enterprises in the region, attracting more investments to the region and preserving cultural heritage through cultural interactions. However, tourism also has negative effects such as the increase in demand for imported products to be able to meet the expectations of foreign tourists, the commodification of cultural heritage in the region, the loss of properties of authentic values in the region, the conflicts arising from the use of resources in the region (between the local people and tourists), pollution, historical artifacts smuggling, the increase in crime rates, child labour, sexual abuse and the conflicts arising from the use of land (Yılmaz, 2007a). On the other hand, Yılmaz (2007b) claimed that there are several negative effects of tourism on environment such as the destruction of natural habitats, soil erosion, desertification, acid rains caused by the use of fossil fuels, climate change, the increase in greenhouse gas emissions, the high population in coastal regions, unplanned constructions, the decrease in supplying drinking water, increasing worries about food safety and human health.

SOCIO-ECONOMIC DEVELOPMENT

Although tourism has some positive effects on socio-economic and environmental development, it can also cause irreversible dreadful results if it is misguided. Consequently, ensuring the sustainability of resources by using the resources properly in tourism will improve the quality of life both today and tomorrow (Can, 2013). The purpose of sustainable tourism is to revive the economy of the region by preserving the natural and cultural resources (Alkan, 2015). Sustainable tourism is the most significant part of sustainable development. The World Tourism Organization considers sustainable tourism as an ecological process in which the basic ecological processes and biodiversity are preserved and all resources are managed in an effective way.

Sustainable tourism is a versatile process. This process has economic, cultural, social and ecological dimensions. Economically, sustainability requires the use and the management of resources in a way which enables the transfer of these sources to the future generations. Ecologically, sustainability provides

the development which has the capacity to protect ecological processes and biological diversity. Socially and culturally, sustainability offers an understanding which protects the socio-cultural values of humans and distributes the benefits obtained as a result of development in society in a fair way (Timur & Getz, 2009; Balyev, 2018). One of the most significant features of sustainable tourism is the fact that it requires a long-term approach. In sustainable tourism, carrying capacity of natural and cultural areas is taken into consideration and negative effects of tourism on nature and culture are tried to be minimised. Even though the support of the local residents to tourism is important, the distinctive environmental sources and local enterprises have to be considered in sustainable tourism (Balyev, 2018). The management of planning and development in tourism is an effective way to minimise the negative socio-cultural and environmental impacts of tourism. Therefore, in sustainable tourism, the economic contributions of tourism are used to assure the sustainability of environmental and natural sources. Thus, the negative impacts of tourism are tried to be minimised (Yazdi, 2012). To sum up, sustainable tourism, which is a type of tourism based on sustainable development principles, is not a kind of tourism that is responsible for only socio-cultural environment and local residents. This type of tourism is also for social justice, economic development and future generations (Park & Yoon, 2011; Balyev, 2018). Sustainable tourism, which ensures the balance between ecology and economy, is perceived as an environmentally sensitive tourism. Though eco-tourism and alternative tourism are regarded as substituting concepts for sustainable tourism, sustainable tourism represents an approach in the fulfillment of touristic activities rather than a tourism type. In this respect, it is possible to implement all types of tourism within the framework of sustainability understanding (Akşit, 2007). Consequently, sustainable tourism requires being sensitive towards nature, culture, history and environment.

The countries, which want to benefit more from the economic contributions of tourism (increasing employment, providing foreign currency income, reducing the deficits in the balance of payments etc.), have made more efforts for the rapid improvement of tourism. Those periods were the times when mass tourism is encouraged in the world. During those periods, the countries, which wanted to benefit from the economic effects of tourism, unfortunately ignored the optimal use of environmental sources and made no efforts for the planned development of tourism. Furthermore, they did not consider the carrying capacity of the region in touristic activities. Particularly developing countries, which regard tourism as an alternative for economic development, have been so concessive for the improvement of mass tourism (Gökdeniz, 2004). In this respect, they turned a blind eye to the destruction of environmental values. This process has caused the deformation of the social, natural and cultural structure in the long-term. Aransson (1994) claimed that sustainable tourism emerged as a reaction of the host country and local residents to the negative effects of tourism. Tourism is a phenomenon based on environment and it consists of multiple interactions affecting the environment and also being affected by the environment. In order to provide the productivity of these interactions, it is important to adopt an understanding, which enables optimal use of environmental sources and avoids the destruction of ecological values. Sustainable tourism is an extension of sustainable development. In this understanding, tourism is considered as an element of ecology. However, touristic interactions are suppressed on the axis of ecology (Doğan, 2010).

THE TARGETS OF SUSTAINABLE TOURISM

Sustainable tourism is a versatile approach. This approach has various targets ranging from biodiversity to economic sustainability. These targets are stated below (Tüsiad, 2012):

Sustainability Tourism and Socio-Economic Development

- *Economic sustainability: To ensure the permanency of tourism destinations and businesses in the long-term to help them develop and to improve their competitive skills.*
- *Local welfare: To maximize the economic contribution of tourism to the destination by increasing the expenditure rates.*
- *The quality of employment: To increase the volume and the quality of local employment opportunities offered by tourism. To ensure the increase of quality and wages without any discrimination for these employment opportunities.*
- *Social equality: To provide a fair distribution of tourism incomes. To give the priority to poor people in this distribution, to provide equal opportunities to the poor and to make efforts in order to improve the services provided to the poor.*
- *The satisfaction of visitors: To assure that all tourists have a safe and satisfying touristic experience without a race, language or religion discrimination.*
- *Local control: To encourage the planned growth of tourism in the region. In this respect, to ensure that the tourism stakeholders consult with each other and to assure the involvement of particularly local administrations into the process. To make it possible for the local administrations and all other stakeholders to have the right to express themselves about the planned growth of tourism.*
- *Social welfare: To maintain and even improve the life qualities of local people. To assure equal access of local residents and visitors to resources without harming the social structure and environment.*
- *Cultural wealth: To preserve, improve and strengthen the socio-cultural values of the region which welcomes tourists. To make sure that the culture, traditions and customs of local people are respected.*
- *Physical integrity: To prevent the destruction of environmental values, physical and visual elements of the region. To preserve the urban and rural areas and to increase the quality of these areas.*
- *Biodiversity: To support the protection of wildlife and to prevent possible damages by taking precautions. To ensure the sustainability of natural areas, habitats and ecological values.*
- *The productivity of resources: To provide the efficient and limited use of non-renewable resources. To restrict the tourism enterprises in terms of the use of these non-renewable resources and even to minimise the use of these resources.*
- *Environmental purity: To take precautions about the pollution and the wastes resulted from touristic interactions. To minimise air and land pollution, water contamination. To minimise the waste generation.*

THE PRINCIPLES OF SUSTAINABLE TOURISM

Several principles have to be followed in order to assure the sustainability of the environmental values which constitute the source of tourism without losing their qualitative and quantitative features. These principles are stated below (Çelik, 2014):

- *Sustainable tourism should consider the needs of all stakeholders in the destination and create a versatile feeling of satisfaction among these stakeholders.*
- *Sustainable tourism should reduce existing poverty and inequality in distribution.*

- *Sustainable tourism should boost the self-esteem of the local people in the destination and help them feel free. Therefore, the local residents should be freed from dogmatic beliefs and efforts should be made to raise the awareness of local people in sustainable tourism.*
- *The priority is the regional and local economy in sustainable tourism. Sustainable tourism should first promote local economy. In sustainable tourism, the contributions of tourism to the economy of the region should be distributed among all stakeholders in a fair way. Justice should be ensured in the distribution of economic contributions and particularly the interests of local residents should be given priority.*
- *In sustainable tourism, there is a planned development of tourism. In this planned development of tourism, a synergy should be generated and a consensus should be achieved among the stakeholders. Sustainable tourism should be regarded as a part of sustainable development strategy. A destination management organization, which consists of local administrations, tourism companies, non-governmental organizations and local residents, should be founded for sustainable tourism.*
- *Ethical principles should always have priority in sustainable tourism, and the host country's socio-cultural values and traditional lifestyles should be respected. The socio-cultural and environmental values of the host country should be brought in tourism without being abused or commoditized.*
- *Justice should be assured in the access of local people and tourists to the resources in the region, and the socio-economic and cultural carrying capacity of the region should not be exceeded. In this respect, planning is necessary in the use of resources by taking the economical use of resources into consideration.*
- *The sustainability of the local people's income from tourism should be ensured, the sustainability of the values that form the source of tourism in the region should be given priority and the destruction of the environmental values should not be allowed in order to obtain income from tourism.*
- *It should be ensured that the benefits obtained from tourism are effective in every part of the region. Thus, all groups of interest and particularly the local residents in the region have access to these benefits in an equal way.*
- *More studies should be carried out about the impacts of tourism on ecological, social and cultural environment. Moreover, the findings of these studies should be shared with all groups of interests and these impacts should be considered in the development of the region in terms of tourism. The local people should be encouraged to conserve and be proud of their own socio-cultural values. Furthermore, the awareness of the local people should be raised about the preservation and the protection of these values. The destination management organizations should regard these principles as their missions and give efforts in this issue.*
- *There should be consistency between the economic development strategies and the tourism development strategies in the region. A great care should be given so that these two strategies support each other. The benefits obtained from tourism should be based on a long-term approach. Hence, the strategies to be applied in the industry should be approached in a holistic way and also these strategies should be proactive.*
- *Sustainable tourism is a future-oriented approach. In this approach, it is essential that the future generations have access to existing resources. Therefore, the values which constitute the source of tourism should be preserved and maintained so as to help the future generations access these existing resources in an equal way.*

Sustainability Tourism and Socio-Economic Development

To sum up, ensuring the continuity of the ecological processes in the region and providing the optimal use of socio-cultural and environmental values that constitute the source of tourism are among the most basic principles of sustainable tourism. In addition to this, assuring that the local-social-cultural values of the region are respected; the cultural values of the region are understood in a better way by the foreigners; the current cultural heritage is preserved and this heritage is passed on to the future generations constitute the core of sustainability approach. Economically, the sustainability of the income obtained from tourism should be ensured and the benefits of the local people from tourism should be given priority. The focus should be on reducing poverty, using incomes from tourism as a source to provide social services to the local people and improving the quality of life of the local residents (Çelik, 2014). On the other hand, Can (2008) stated that environmental resources might be different in every region and sustainable principles related to tourism might be defined in the framework of certain criteria (Yılmaz, Ünal & Çakır, 2015). These principles are stated below (Can, 2008):

- *Sustainable tourism should be designed according to supply not demand.*
- *All priorities belong to the local people in sustainable tourism.*
- *It is aimed to spread tourism activities to 12 months in sustainable tourism. Rather than the intensive short-term use of destination, extensive mild use of it is planned. Accordingly, the sustainability of tourism becomes harder in the seasonal use of the region for tourism purposes.*
- *Infrastructure and public services for public transport services in the region should be strengthened.*
- *The participation of the local communities and non-governmental public organizations of the region in destination management organizations should be promoted and these communities should be provided with the opportunity to express themselves in terms of developing tourism-oriented strategies.*
- *Clean energy resources should be given priority in tourism activities in the region.*
- *Instead of artificial attractions which constitute the source of tourism in the region, the unique, natural-social-cultural and environmental beauties and attractions of the region should be outshone. From this point of view, the existing building structures should be examined first. Thus, the social and cultural identity of the region should be preserved.*
- *The opportunity to make tourism investments long-term and flexible should be provided and these investments should be considered as a tool for sustainable development of the region.*

TOOLS OF SUSTAINABLE TOURISM

There are several tools for the sustainable development of tourism, which is regarded as developmental tool especially in the developing regions. The sustainability of tourism in the region can be checked by using these tools. These tools are carrying capacity, environmental impact assessment and ecological footprint.

Carrying Capacity

Carrying capacity is an approach which is based on the sustainability of the resources of the region. Generally, carrying capacity is defined as the limit of the endurance or preserving a living thing or an atmosphere without losing its functionality and maintaining its beauties (Gökтуğ et. al., 2014). On the one

hand, Baliyev (2018) considers carrying capacity as the maximum number of people that the destination is able to accept, taking the socio-cultural-ecological and environmental values of the destination into consideration without a decrease in the quality of the visitors' experiences. This concept, which was used in ecology previously, is based on the idea that the sustainability of the habitat should be ensured. From a modern point of view, carrying capacity represents the maximum number of people that a region can accept without destroying the natural, cultural and social environment. This concept is highly significant in terms of planning and managing sustainable tourism in the region. Carrying capacity, which is used as a tool in determining the effects of tourism in the region, demonstrates whether the impacts of tourism are acceptable or not. Hence, the carrying capacity of the region should be taken into consideration in planning tourism (Çalık, 2104; Çeti, 2018). On the other hand, the type of tourism, place and time (low season- high season) are among the concepts which affect carrying capacity (Çeti, 2018). An uncontrolled growth and development puts pressure on environmental resources. The carrying capacity of environmental values should be considered in order to be able to preserve environmental resources and pass these resources on to the future generations (Çelik, 2014).

In carrying capacity, it is essential that there is not an unacceptable change in physical environment and an unacceptable decrease in the quality of visitors' experiences. Carrying capacity is examined from an economic and a social point of view. *Social carrying capacity* is based on the level of the visitors' impacts on the society. In *economic carrying capacity*, the economic contributions and costs of tourism to the region are considered. The balance between the economic contributions and costs of tourism is called "economic carrying capacity". The acceptable limit of the impacts of tourism on nature is defined as *ecological carrying capacity*. Briefly, ecological carrying capacity is also described as the degree of impact of tourism on physical environment. However, *physical carrying capacity* refers to the maximum number of visitors which the recreation area in the destination can accept in a certain period of time. In order to promote sustainable tourism, the limit values of these four carrying capacity types (social, economic, ecological and environmental) should not be exceeded (Algan & Bayraktar, 2018). On the other hand, Sonuç (2014) examined carrying capacity with a different point of view in five categories. These capacity types are stated below:

- *Physical carrying capacity*: This type of capacity, which is also considered as the bed capacity, represents the maximum number of visitors that will be accommodated in the region.
- *Ecological carrying capacity*: In this type of carrying capacity, which is based on the impacts of tourism on natural environment, the optimal use of natural resources is taken into consideration so as to pass the ecological values on to the future generations.
- *Psychological carrying capacity*: Social carrying capacity is seen as a reaction of the local people to tourism. Nevertheless, psychological carrying capacity refers to the carrying capacity related to the satisfaction of the visitors (Çeti, 2018). Psychological carrying capacity is concerned about the quality of the visitors' experiences in the destination and it points out at the lowest perceptual level of satisfaction before visitors start looking for alternative destinations (Sonuç, 2014).
- *Social carrying capacity*: Social carrying capacity is regarded as the attitude or the level of tolerance of local people towards the presence and the behaviours of tourists in the destination (O'Reilly, 1986: 256). In short, it can also be defined as the tolerance of local people towards the presence of tourists. Social carrying capacity and psychological carrying capacity are in an interaction with each other. In other words, the tolerance of the local people towards the presence and

the behaviours of tourists affect the quality of the visitors' experiences in the destination (Çeti, 2018).

- *Economic carrying capacity*: It is the concept which refers to the optimum balance between the benefits of tourism to the economy of the region and the costs of tourism. Factors such as touristic investment, vacation costs, tourist volume and the satisfaction level of the local people are some of the factors which affect economic carrying capacity (Özdemir, 2007). In other words, economic carrying capacity expresses the optimum balance between the economic contributions of tourism in a particular region and the costs which should be tolerated in order to achieve these contributions. This type of capacity is shaped as a consequence of benefit-cost analyses of tourism (Papageorgiou & Brotherton, 1999: 271; Çeti, 2018).

The types of capacity, which have been examined, are not independent from each other. On the contrary, they are closely related to each other. Not exceeding the limit values of these carrying capacity types is highly important so as to ensure the sustainability of the resources in the region (Çeti, 2018). The threshold value of each capacity type is different in a destination. For instance, while the physical capacity is not exceeded in one destination, the ecological carrying capacity might highly be exceeded.

Environmental Impact Assessment (EIA)

Before economic activities start taking place, possible negative impacts on environment should be detected and these negative impacts should be prevented before they occur as a requirement of sustainable development. Environmental Impact Assessment is a prediction and prevention strategy. Thus, it is necessary to predict possible negative impacts of activities or projects on natural resources and develop some strategies in order to prevent these negative impacts. Environmental impact assessment is an approach, which aims at preserving the healthy environment and achieving sustainable development (Escioğlu, 2007). The common point of the definitions about EIA is that it is a process starting before economic activities, it can be monitored during the economic activities and the monitoring and the assessment continue after the activities have ended (Duru 2014; Turan & Güner, 2017). According to EIA legislation, environmental impact assessment is considered as “all sort of activities determining the effects of the planned projects on the environment, taking precautions to prevent the negative impacts or minimise these impacts so that they will not destroy the environment, monitoring and controlling the environmental effects during the implementation of the projects” (Tekayak, 2014: 141; Gürbüz, 2020). According to another definition of Environmental Impact Assessment, it is expressed as the process of defining, predicting, assessing and minimising the possible impacts before making a decision of investment (Sousa, Gomes & Formigo, 2010: 466; Gürbüz, 2020). To sum up, EIA is a decision-making process which assesses the probable impacts of a project or an activity on social environment and people in a systematic way. An activity needs to be systematic, objective and interdisciplinary in order to assess its environmental impacts. For an environmental impact assessment, first a project manager, an ecologist / a biologist, a sociologist / an anthropologist, a geographer / a hydrologist / soil scientist and an urban planner are needed (Environmental Assessment Sourcebook, 1991). The impacts of the planned activity on the air, water, soil quality, flora, fauna and human resources of the region should be assessed in environmental impact assessment (Gündüz, 1999). Carrying capacity is a considerably necessary sustainability tool in terms of determining the extent to which the region can maintain tourism activities. However, despite all these properties, carrying capacity is not a sufficient tool alone to assure the sustainability. From this

point of view, environmental, social and economic impacts of the investment should be assessed while tourism assessments are still in the stage of planning. Environmental impact assessment for tourism is complementary to carrying capacity. It is necessary to use both tools during the stage of planning the investments (Çelik, 2014). In this respect, Environmental Impact Assessment (EIA) should be included in the stage of planning the investments, the environmental impacts of the investments should be assessed in the early stages of the investments, and the investment project should be in harmony with the environmental targets. Furthermore, the decision should be made in accordance with the EIA Report before making a decision of investment and also the attitude of the local people and socio-cultural resources should be taken into consideration in the process of EIA (Republic of Turkey Ministry of Culture and Tourism, 2020). According to the legislation, the hotels and the holiday villages with a minimum capacity of 500 beds are within the scope of projects which have to carry out environmental impact assessment. On the other hand, even though the EIA Report is a time-consuming process, it is a significant tool for sustainable development which contributes to the local residents and the economy of the region in the long-term period (Çelik, 2014).

Ecological Footprint

Ecological footprint is a method which has been developed in order to help the ecosystem regain the balance that has been lost as a result of human activities. In other words, as a consequence of the increase in mass production with industrialization, the uncontrolled use of ecological resources started. As a result of this, the ecological balance has been lost. The concept of ecological footprint was proposed by Wackernagel and Rees (1996) as a consequence of the increasing awareness about helping the ecology regain the balance that was lost. The concept is an ecological sustainability criterion which is used in assessing the destruction in the natural resources. In ecological footprint, the self-renewal speed of the ecosystem is taken into account. The ecological footprint is a calculation method, which reduces and even eliminates the damages caused by humans to the nature. Ecological footprint is a concept which expresses the effects of the pressure caused by human actions on the nature. Factors such as the consumption habits, the transportation and the accommodation preferences of human beings, the rise in population, technological developments and urbanization have damaged the ecological balance. This destruction brought on the danger of the depletion of ecological resources. The concept of ecological footprint, which emphasizes the sustainability of life and sustainability in order to leave a well-preserved environment to the future generations, measures the biological capacity to provide the reproduction of the consumed natural resources and to neutralize the wastes (Semtrio, 2020). Briefly, ecological footprint is a sustainability tool which aims at measuring the impact of human activities on nature and ecosystem. First of all, the biological capacity should be assessed to be able to measure this impact. Biological capacity is the calculation of the production capacity of renewable natural resources of a region. The minimum sustainability criterion is determined by comparing the ecological footprint and biological capacity criteria. In this perspective, ecological footprint should be less than the total biological capacity. Therefore, it is possible to take some measures such as using the natural resources in a careful way which does not exceed the ecological limits, not using the fertile agricultural lands for touristic purposes, consuming local and seasonal vegetables and fruits in tourist complexes, and also encouraging the visitors to use bicycles for short distances (Çelik, 2014).

The national scale formula of calculating ecological footprint is stated below: Ecological Footprint (ha) = Consumption x Production Area x Population

The consumption variable, which is used in the formula, is considered as the usage measure of the goods. On the other hand, the production variable, which is used in the formula, is the amount of biologically productive area which is necessary to assure the sustainability of consumption in a particular area. Agriculture fields, grazing lands, forests, seas and built-up lands are taken into consideration when the productive area is calculated. Biologically productive area refers to the total area of the biosphere with the ability to renew itself (Akillı, Kemahlı, Okudan & Polat, 2008). Moreover, there are types of ecological footprint such as (1) carbon footprint, (2) cropland footprint, (3) built-up land footprint, (4) forest footprint, (5) fishing grounds footprint and (6) grazing land footprint. However, carbon footprint has a greater impact and a bigger growth capacity than the impacts of all other components. Hence, carbon footprint should be reduced first in order to be able to reduce ecological footprint (Semtrio, 2020). The types of ecological footprint are stated below:

- *Carbon footprint:* Carbon footprint is considered as the damage of human actions to the nature. There are two types of carbon footprint: primary and secondary. Primary carbon footprint is highly crucial in terms of understanding the damage to the environment. Primary carbon footprint is the sum of greenhouse gas (carbon dioxide) in the atmosphere released as a result of the use of fossil fuels, as a consequence of domestic energy consumption and transportation. Secondary carbon footprint results from the life cycle products used by humans. It is the sum of carbon dioxide released after the production of the products consumed and their turning into waste products afterwards (Karbayakizi, 2020). The biggest component of carbon footprint is the carbon dioxide which is released as a result of the use of fossil fuels for energy consumption and transportation. First of all, the use of low-carbon cars, bicycles and public transportation vehicles such as trains should be promoted so as to reduce carbon footprint. In addition to this, the consumption of domestic energy should be decreased; the use of renewable energy resources such as solar, wind and water energy should be encouraged. In order to reduce secondary carbon footprint, domestic food and beverages should be preferred instead of imported food and beverage products, food and beverage products coming from long distances should not be preferred, the consumption of meat should be reduced and packaged products should not be preferred.
- *Cropland footprint:* It is the calculation of the lands used for food, animal food, oil crops and rubber production for human consumption. A crucial part (83%) of cropland footprint in Turkey is related to food (Climatechange, 2020).
- *Built-up land footprint:* It is the sum of all infrastructure and superstructure used to meet the needs of humans including housing, transportation, industrial structures and power plants. Built-up land footprint constitutes 3% of total ecological footprint (Climatechange, 2020).
- *Forest footprint:* It refers to the total forest area which is used to meet the needs such as timber / lumber, pulp and firewood consumed (Climatechange, 2020).
- *Fishing grounds footprint:* It is the calculation of the sea and fresh water area which is used to supply the fish and the seafood consumed (Climatechange, 2020).
- *Grazing land footprint:* It is the calculation of livestock areas necessary for meat, milk, leather and wool products (Climatechange, 2020).

CONCLUSION

Sustainable tourism provides noteworthy opportunities to create a healthy future. Thus, first of all, the concepts of sustainable development and sustainable tourism had been examined in a systematic point of view, and then the purposes, the principles and the tools of sustainable tourism were evaluated in this study. Consequently, this study has some suggestions primarily for the destination management organizations and also the sector. These suggestions are stated below:

- The amount of waste can be reduced by using renewable energy resources. By this way, it may also be possible to save energy resources. If there alternative tourism types in the region, this may provide diversity in touristic products. Hence, four-season tourism will be possible in the region and this will allow the use of the region below its carrying capacity (Erkara, 2019). Transportation, which constitutes a significant part of touristic expenditures, is the most important element of touristic products. The greatest component of carbon footprint calculations is related to the use of fossil fuels as a source of energy. Therefore, the use of public transport such as trains and the use of bicycles should be promoted and the use of these vehicles for tourism purposes should be encouraged.
- In terms of transportation, some organizations such as space and garage arrangements in the environment should be made; vehicle-free zones should be created in the region and public parking of private vehicles should be promoted in an area far away from public transportation stops (Knoflachner & Vesile, 2011). In addition to this, a variety of energy resources may be used for a more sustainable transportation in tourism; regional energy advantages such as wind/water/solar can be used and the mode of transportation can be shifted to the transportation via the sea and the railways (Öter, 2007)
- A holistic approach should be adopted in the plans and the policies related to tourism, the socio-cultural structure in the region should be preserved, the carrying capacity of the region should be taken into account, ecology, economy and environment should be regarded as the parts of a whole. The environmental impact assessment of the future investments should be carried out. Furthermore, the positive and negative impacts of the investments on the environment should be taken into consideration. In all touristic activities which have been planned to take place in the region, the conservation-use balance of ecological and environmental values should be considered. The benefits which will be gained as a result of these activities and the costs tolerated for these benefits should be evaluated and a fair distribution of the obtained benefits to the whole society should be ensured. The cultural values peculiar to the region should be brought in tourism without being commoditized. Nonetheless, the visitors should be encouraged to respect these values. Furthermore, the protection of the common cultural heritage of the region by all stakeholders should be promoted.
- The controlled development of tourism should be fundamental in the action plans of tourism development in the region. Moreover, precautions should be taken against touristic activities which do not meet sustainable tourism principles. The most valuable group of interest is the local people in sustainable tourism. From this point of view, it is necessary to observe the tolerance levels of local people towards visitors and not only the satisfaction of the tourist, but also the satisfaction of the local residents about tourism should be taken into account. In accordance with this, the par-

Sustainability Tourism and Socio-Economic Development

ticipation of local people to all processes related to tourism should be assured and the awareness of the local people should be raised about the preservation of the local cultural heritage.

- The incomes obtained from tourism should be used to increase the life standards of the local people in the region. The carrying capacity of all touristic attractions in the region should be calculated, environmental impact assessment of the touristic investments should be carried out, and also ecological footprint evaluation of the local people and the visitors should be made. Furthermore, it is significant to pay attention to the limit values. Thus, all touristic activities in the region should not exceed the limit values in these assessments. It should be ensured that the visitors and the tourists respect the local culture, beliefs and authenticity. Accordingly, measures should be taken and especially the tolerance level of the local people should be given importance.
- Restricting tourism facilities especially in ecologically sensitive areas will be effective in terms of making it possible for the areas to regain the ecological balance. Tourism companies should carry out their activities in line with sustainability. The facilities, which are considered to increase environmental sensitivity, should be supported. Moreover, the sustainability awareness of the employees in the tourism industry should be increased and necessary precautions related to waste should be taken (Yılmaz, 2007b).

In conclusion, developing countries can encourage the frequent use of blue flag and green star applications in the sector. All processes of current tourism companies can be inspected and some deterrent sanctions can be imposed in order to achieve sustainability (Karayılan, 2014). Strict measures should be taken particularly against the unsustainable practices of the hotels which have an all-inclusive system. Developing countries should encourage tourism companies to use environmentally friendly green energy and establish businesses which are suitable for traditional architectural structure. Moreover, they should support such valuable and advantageous projects. On the other hand, small destinations, which are not economically developed, but have natural and unspoiled environmental values have more potential in terms of sustainable development. In this respect, it is recommended that such destinations are brought into tourism without losing their authentic values. Instead of over-centralized planning, a planning in which local administrations (non-governmental organizations, universities, municipalities, tourism companies, and development agencies) are strengthened should be adopted in tourism planning. In addition to this, the development should be holistic. The awareness of the society on sustainability should be raised along with the tourism sector and the participation of the community in practices related to sustainability should be assured. As a matter of fact, it is not possible to expect any approach to be successful in the long term without the support and participation of the society.

REFERENCES

Akıllı, H., Kemahlı, F., Okudan, K., & Polat, F. (2008). The content of ecological footprint concept and calculation of individual ecological footprint in the Akdeniz University economics and administrative sciences faculty. *Akdeniz İİBF Journal*, 8(15), 1-25. Retrieved from <https://dergipark.org.tr/tr/pub/auibfd/issue/32317/359129>

Akşit, S. (2007). *Sustainable Tourism in Terms of Natural Environment Awareness* (Unpublished Master's Thesis). Erciyes University, Erciyes.

- Algan, N., & Bayraktar, M. (2018). *Turizm Sektörüne Taşıma Kapasitesi ve Çeşitleri*. ICPESS.
- Alkan, C. (2015). Sustainable tourism: An application for Alaçatı destination. *Journal of Yaşar University*, 10(40), 6692–6710.
- Aransson, L. (1994). Sustainable Tourism Systems: The Example of Sustainable. Rural Tourism in Sweden. *Journal of Sustainable Tourism*, 2(1-2), 77–92. doi:10.1080/09669589409510685
- Balıyev, V. (2018). *Evaluation of mountaineering sport in terms of tourism effect: The case of Azerbaijan* (Unpublished Master's Thesis). Akdeniz University, Antalya.
- Bruyninckx, H. (2019). *A healthy environment is an obligations for sustainable economy and a fair society*. <https://www.eea.europa.eu/tr/articles/saglikli-cevre-surdurulebilir-ekonomi-ve>
- Çalık, A. Ö. (2014). *The social carrying capacity of touristic centers: Beypazarı case study* (Unpublished Doctoral Thesis). Gazi University, Ankara.
- Can, E. (2013). Evaluation of Sustainable Tourism in Tourism Destinations in Terms of Sustainable Competitiveness. *Istanbul Journal of Social Sciences*, 4, 23–40.
- Can, M. D. (2008). *Sürdürülebilir Turizm ve Turizm Çeşitliliği Kapsamında Kültür ve Turizm Koruma ve Gelişim Bölgeleri: Mersin-Tarsus Örneği* (Doctorate Thesis). Republic of Turkey Ministry of Culture and Tourism, Ankara.
- Çelik, N. (2014). *The effects of sustainable tourism practices on tourism demand: The case of Muğla* (Unpublished Master's Thesis). Muğla Sıtkı Koçman University, Muğla.
- Çeti, B. (2018). Evaluating the Concept of Carrying Capacity in the Context of Tourism Policy and Planning. *Journal of Business Management and Economic Research*, 1, 1–17. doi:10.29226/TR1001.2018.84
- Climatechange. (2020). *What is a Carbon Footprint?* <http://climatechange.boun.edu.tr/ekolojik-ayak-izi-nedir/>
- Crouch, I. G., & Ritchie, B. (1999). Brent, Tourism, Competitiveness and Social Prosperity. *Journal of Business Research*, 44(1), 137–152. doi:10.1016/S0148-2963(97)00196-3
- Doğan, M. (2010). *Sustainable Destination of Focused On Ecomuseum And An Implementation Above Gökceada* (Unpublished Master's Thesis). Çanakkale University, Çanakkale.
- Doğan, M. (2010). *Sustainable destination of focused on ecomuseum and an implementation above Gökçeada* (Unpublished Master's Thesis). Çanakkale Onsekiz Mart University, Çanakkale.
- Duru, B. (2014). *Yeni ÇED Yönetmeliğinin Anlamı*. <http://kentcevre.politics.ankara.edu.tr/Duru%20CED%20Yonetmeligi%20.pdf>
- Erkara, A. (2019). *Determination of the principles of sustainable tourism in urban* (Unpublished Master's Thesis). Gazi University, Ankara.
- Esgicioğlu, N. (2007). *Problems faced and solution recommendations in the environmental impact assessment applications in Turkey* (Unpublished Master's Thesis). Çukurova University, Adana.

Sustainability Tourism and Socio-Economic Development

Gökdeniz, A. (2004). Local Agenda 21 and Eco Tourism within the framework of Sustainable Tourism Policies. *Journal of Standard*.

Göktuğ, T. H., Demircioğlu Yıldız, N., Demir, M., & Bulut, Y. (2013). Formation- Development and Modelling Process of Carrying Capacity Theory in the National Parks. *Atatürk Univ. J. of the Agricultural Faculty*, 44(2), 195–206.

Gündüz, F. (1999). *Environmental impact assessment of tourism and environment sensitive sustainable tourism model* (Unpublished Doctoral Thesis). Istanbul Technical University, Istanbul.

Gürbüz, K. (2020). Changes in the Legislation of Environmental Impact Assessment in Turkey. *Library. Archive and Museum Research Journal*, 3(1), 39–47.

Heslinga, J., Groote, P., & Vanclay, F. (2019). Strengthening governance processes to improve benefit-sharing from tourism in protected areas by using stakeholder analysis. *Journal of Sustainable Tourism*, 27(6), 773–787. doi:10.1080/09669582.2017.1408635

Karayılan, E. (2014). *Examining the relationship between sustainable tourism policies and community participation from an institutional perspective in developing countries: The case of Turkey* (Unpublished Doctoral Thesis). Istanbul University, Istanbul.

Karbonayakizi. (2020). *What is a Carbon Footprint?* <http://www.karbonayakizi.com/whatiscarbon-footprint.html>

Kılıç, S. (2012). An ecological approach to the economic dimension of sustainable development concept. *Journal of I. U. Political Science*, 47, 2012–2226.

Knoflacher, H., & Vesile, E. O. (2011). Discussions on the Concept of Sustainable Transportation. *TMH*, 51-58. https://www.imo.org.tr/resimler/dosya_ekler/8a03dde7a90e701_ek.pdf?dergi=186

Lickorish, J. L., & Jenkins, C. L. (1997). *An Introduction to Tourism*. Heinemann.

McDonald, J. R. (2006). *Understanding sustainable tourism development from a complex systems perspective: A case study of the Swan River, Western Australia* (Unpublished Doctoral Dissertation). Edith Cowan University, Australian.

Niedziolka, I. (2014). Sustainable Tourism Development. *Regional Formation and Development Studies*, 3(8), 157–166.

O'Reilly, A. (1986). Tourism Carrying Capacity. *Tourism Management*, 7(4), 146–225. doi:10.1016/0261-5177(86)90035-X

Oli, G. S., & Chhetri, B. B. (2015). *Hotel Management*. Buddha publications.

Öter, Z. (2007). Turizmde ulaştırma. In Genel turizm. Turhan Publishing.

Özdemir, S. B. (2007). *The importance of carrying capacity in the balance of protecting and using environment: Sample tourism sector* (Unpublished Master's Thesis). Ankara University, Ankara.

Pan, S. Y., Mengyao, G., Kim, H., Shah, K. J., Pei, S. L., & Chiang, P. C. (2018). Advances and challenges in sustainable tourism toward a green economy. *The Science of the Total Environment*, 635, 452–469. doi:10.1016/j.scitotenv.2018.04.134 PMID:29677671

Park, D. B., & Yoon, Y. S. (2011). Developing Sustainable Rural Tourism Evaluation Indicators. *International Journal of Tourism Research*, 13(5), 401–415. doi:10.1002/jtr.804

Porgiou, K., & Brotherton, I. (1999). A Management Planning Framework Based on Ecological, Perceptual and Economic Carrying Capacity: The Case Study of Vikos-Aoos National Park, Greece. *Journal of Environmental Management*, 56(4), 271–284. doi:10.1006/jema.1999.0285

Republic of Turkey Ministry of Culture and Tourism. (n.d.). *Çevresel Etki Değerlendirmesi*. <http://www.ktbayatirimisletmeler.gov.tr/TR,11593/cevresel-etkidegerlendirmesi-ced.html>

Semtrio. (n.d.). *Ekolojik Ayak İzi Nedir?* <https://www.semtrio.com/ekolojik-ayak-izi>

Sonuç, N. (2014). *Sürdürülebilir Turizm: Tanımı ve İçeriği*. In *Metin Kozak*. Detay Publishing.

Sousa, P., Gomes, D., & Formigo, N. (2020). Ecosystem Services in Environmental Impact Assessment. *Energy Reports*, 6(1), 466–471. doi:10.1016/j.egy.2019.09.009

Stabler, M., & Goodall, B. (1997). Environmental awareness, action and performance in the Guernsey hospital sector. *Tourism Management*, 18(1), 19–33. doi:10.1016/S0261-5177(96)00095-7

Tekayak, D. (2014). An Overview of Environmental Impact Assessment in Turkey: Issues and Recommendations. *Ankara Review of European Studies*, 13(2), 133–151.

Timur, S., & Getz, D. (2009). Sustainable Tourism Development: How Do Destination Stakeholders Perceive Sustainable Urban Tourism? *Sustainable Development*, 17(4), 220–232. doi:10.1002/d.384

Turan, E., & Güner, E. (2017). Changes in the Legislation of Environmental Impact Assessment in Turkey. *Journal of Natural Hazards and Environment*, 3(1), 39–47. doi:10.21324/dacd.28618

Tüsiad. (2012). *Sustainable Tourism*. <https://tusiad.org/tr/yayinlar/raporlar/item/6030-surdurulebilir-turizm>

United Nations. (1987). *World Commission on Environment and Development, Our Common Future*. Oxford University Press.

Wackernagel, M., & Rees, W. (1996). *Our Ecological Footprint: Reducing Human Impact on the Earth*. New Society Publishers.

Wikipedia. (2020). *Sustainability*. <https://en.wikipedia.org/wiki/Sustainability>

WTTC. (2020). *Economic Impact Reports*. <https://wtcc.org/Research/Economic-Impact>

Yazdi, S. K. (2012). Sustainable Tourism. *American International Journal of Social Science*, 1(1), 50–56.

Yılmaz, B. S. (2007a). Turizmin sosyo-ekonomik, sosyokültürel ve çevresel etkileri. In Genel Turizm. Turhan Publishing.

Yılmaz, B. S. (2007b). Turizm ve Çevre. In Genel Turizm. Turhan Publishing.

Sustainability Tourism and Socio-Economic Development

Yılmaz, İ., Ünal, A., & Çakır, G. (2015). An evaluation on sustainable tourism literature: The context of Turkey. *MBD*, 4(2), 55-83. Retrieved from <https://dergipark.org.tr/en/pub/mbd/issue/34071/377077>

Yu, K. D. (2012). An economic analysis of the Philippine tourism industry. *DLSU Business & Economics Review*, 22(1), 119-128. <https://ejournals.ph/article.php?id=6450>

Chapter 17

Material Flow Cost Accounting (MFCA): A Green Management Tool (GMT) for Hotel Business

Omolola Ayobamidele Arise

University of Kwa-Zulu Natal, South Africa

Patricia Maureen Shewell

University of Kwa-Zulu Natal, South Africa

ABSTRACT

MFCA's potential as a GMT in the hospitality industry has not been well demonstrated. Instead, the manufacturing industry takes the credit for the successful implementation of MFCA. This may be attributed to the industry's inaccurate information on resource consumption and management for strategic internal decision-making. Greening in hotels has predominantly been viewed from customers' perspectives to gain a competitive advantage and improve profits. MFCA is presented in this chapter as a GMT to achieve eco-friendly hotel business practices via informed resource utilization data. Natural resources such as water and energy are gradually becoming scarce commodities with waste generation on the rise and environmental sustainability of the hotel business threatened. Hotels face pressure from the global market to improve their sustainability performance by implementing green practices. In meeting the requirements of sustainable practice, green management's goal focuses on reducing, eliminating, and preventing adverse effects arising from environmental activities.

INTRODUCTION

Resource consumption and climate change in the hospitality and tourism industry are considered common global environmental menaces requiring green intervention. The concept of green intervention in the hospitality industry was described by Scholz (2016b) as a mediation of environmentally friendly practices through the efficient use of energy, water and materials while providing quality services. The mediation

DOI: 10.4018/978-1-7998-7967-1.ch017

Material Flow Cost Accounting (MFCA)

of greening of the hospitality industry became important when hotels recognised that attaining a green image was no longer a movement. Rather, it is a conventional current involving an eco-friendly status to aim environmentally cognizant customers, to gain differentiation benefits and yield premium prices for their services (Fuentes-Moraleda, Lafuente-Ibáñez, Muñoz-Mazón, & Villacé-Molinero, 2019). Green commitments was designed by many hotels to improve their environmental performance due to pressure from external stakeholders (E. S. Chan, Okumus, & Chan, 2020). The focus of greening in hotels has predominantly been on diverse environmental practices ranging from customers' perspectives to gain a competitive advantage to improving profits. The direction, however, shows customers' perceptions as the motivation for most hotels adopting green practices. This may be one reason the hotel business has given little attention to greening from an environmental management accounting (EMA) perspective.

Environmental concern in the tourism and hospitality industry is usually attributed to the significant developments and expansion the industry has experienced as one of the fastest emerging industries globally (Abdou, Hassan, Dief, & Moustafa, 2020). Up to 10.4% of global gross domestic product (GDP) is contributed by this sector. It is alleged to be a critical enabler of economic development globally, driving about 7% of global exports (Merli, Preziosi, Acampora, & Ali, 2019). The developments and improvements in the industry leave a trail of adverse environmental impacts in their paths. The report published by the United Nations World Tourism Organisation shows that of the approximately 5% of the total carbon dioxide (CO₂) emissions generated by the industry globally, 2% is caused by the hotels, with a projected increase of 130% in 2035 (Aragon-Correa, Martin-Tapia, & de la Torre-Ruiz, 2015). It seems a gloomy future was predicted for the global environment due to the tourism and hospitality industry's activities. Over the years, more and more research has been published on emissions giving credence to the prediction. Although, being a global economic force, and the United Nations current key to accomplishing its 17 sustainable development goals (SDG) and 169 related targets (Abdou et al., 2020), the overall adverse environmental impact of the hospitality and tourism industry cannot be underestimated nor ignored as development should not be at the expense of responsible tourism. Therefore, attaining a suitable eco-friendly environment is considered an international obligation that involves all business domains in maintaining sustainable competitiveness (Huang, Chiu, Chao, & Wang, 2019). The various ecological challenges emanating from various business activities gradually propelled interest in green business initiatives giving rise to varied environmental management techniques. The majority of the methods have become effective in other industries like the manufacturing and mining industries. To balance the hotel business activities with the demands for environmentally friendly processes, hotels need to embrace green accounting. Green accounting can help businesses improve the efficiency and effectiveness of their resources sustainably, thereby aligning the environmental functions development and benefiting the community (Ulupui et al., 2020). Material flow cost accounting (MFCA) is an environmental management accounting technique and a management information system that supports businesses in achieving both economic and environmental performance via the analysis of energy flows and physical material as well as their related costs (Tran & Herzig, 2020). MFCA is a green accounting tool. This chapter's objective investigates the potential of MFCA as a green management tool for the hotel business.

BACKGROUND

The hotel sector forms an vital element of the hospitality and tourism industry (Sucheran, 2013). It stands as one of the significant contributors of organic/wet waste to landfills, which is the leading cause of greenhouse gas (GHG) emissions (Singh, Cranage, & Lee, 2014). Many hotel businesses are now aware of the environment's dynamic nature, particularly concerning climate change, environmental complexities and sustainability. Being a key partner in the hospitality industry, hotels have an essential part in ecological and social responsibility issues, considering the sector is one of the major consumers of scarce resources such as water and energy and a generator of organic waste. Approximately 75% of the hotels' environmental impact is attributed to excessive consumption of natural resources (Graci & Kuehnel, 2011) which indicates that hotels are resource-intensive and many-a-time inefficient in utilising resources at their disposal. The excessive consumption of the aforementioned scarce resources and their consistent depletion is disturbing and confirms the inefficiency in their activities. Countries, particularly the developing countries that are water and energy vulnerable (Donnenfeld, Hedden, & Crookes, 2018), become disadvantaged as the resources are not sufficient. How long can hotels remain sustainable with the consistently increased level of resource consumption? Can the hospitality industry keep up the growth rate when these resources approach total exhaustion, and can hotels accurately measure their resource consumption? These are questions that constantly resonate with the danger looming ahead in this industry. Since greening is a crucial discussion in 21st century business with environmental issues, hotel managers continuously seek effective green initiatives to mitigate their impact on the environment. Going green seems to align with the sustainability concept. Sustainability is a concept that anchors on the platform of present business activities meeting present-day life's needs without threatening the effective and efficient future potentials of natural resources (Marota, 2017). This concept in the hotel industry is geared towards initiatives that are likely to have a vast progressive influence on the society, having solid relations at all levels (social, economic and environmental systems) (Melissen, Cavagnaro, Damen, & Düweke, 2016). Greening in the hotel business should embrace a futuristic approach for sustainability.

ENVIRONMENTAL TRENDS IN THE HOTEL BUSINESS AND ISSUES OF CONCERN

Previously, the hospitality industry would not relate its activities to having any significant negative impact on the environment, considering its non-involvement in manufacturing activities that generate vast consumption of non-renewable resources (Rogerson & Sims, 2012). Due to the increased growth rate in the tourism industry, hotels also face the same phenomena, such as internal and external pressures that force them to pay attention to preserving the environment through eco-friendly services that is not detrimental to the environment and are safer for customers (Yusoff, Nejati, Kee, & Amran, 2020). Despite the growth rate and positive contributions of the tourism and hospitality industry, the industry gets blamed for being one of the leading sources of pollution globally, generating large amounts of municipal solid waste (Abdulredha et al., 2018). Edoun, Mbohwa, and Bhila (2019) confirm that the hospitality industry has damaging waste levels that negatively impact the environment, eco-system and surrounding areas. In the advent of environmental complexities in the tourism industry, green tourism became a moral imperative for hotel businesses globally, going from hardly being discussed to an issue of utmost concern. The persistent problems faced by hotels regarding environmental safety services

Material Flow Cost Accounting (MFCA)

focus on the lack of an effective monitoring system for resource consumption and waste management production (Zaitseva et al., 2019). As hotels largely depend on natural resource consumption such as the use of water, energy, land and the environment at large, a proactive environmental strategy seemed appropriate (Singjai, Winata, & Kummer, 2018) to increase the ecological efficiency and performance (E. S. Chan et al., 2020).

Water Usage

Water resources have emerged as a critical environmental concern for consumers. Nearly one-quarter of the earth's fresh water consumption is for industrial purposes, often creating wastewater; the hotel business also uses large freshwater quantities to launder linens and towels, producing wastewater (Shang, Basil, & Wymer, 2010). The hospitality industry is accountable for substantial environmental impact via its contribution to extreme water strain, depleting groundwater and associated problems such as salinisation and subsidence and water importation (Styles, Schoenberger, & Galvez-Martos, 2015). Several customers seek hotel services expecting to be indulged with lashings of hot water, high-pressure showers, swimming pools, saunas and good drinking water, not to mention the volume of water used in the kitchen for washing and cooking, which is why hotels use so much water. There have been diverse water usage estimates in the hospitality industry depending on the hotels' size and ratings. In an average five-star hotel, the typical hotel water consumed per guest per night ranges between 170 and 440 litres (Mbasera, Du Plessis, Saayman, & Kruger, 2016). Traditional water policies was dedicated to increasing water supplies to meet increasing demands, with substantial social, economic and environmental costs (Tirado, Nilsson, Deya-Tortella, & Garcia, 2019). However, quantitative data on water usage across several critical hospitality industry processes is scarce (Styles et al., 2015).

Energy Consumption

According to the global level International Energy Agency (IEA), energy consumption on the global level continues to increase, leading to substantial carbon dioxide emissions and severe environmental problems (Hakimi, Abedi, & Dadashian, 2020). Energy consumption in a business is a central point of deliberate resource management (Schmidt, 2010). The importance of energy consumption management is clearly emphasised in business processes. Energy is usually one of the highest utility costs in businesses, therefore, it offers an enormous opportunity for savings. The hotel business is one of the sectors that consumes considerable energy for heating, kitchen equipment, air conditioning, lifts, lighting, cleaning and laundry (Cerchione & Bansal, 2020). Hotels have launched various initiatives to reveal their willingness to support sustainability by setting up technologies like solar panels as an eco-friendly initiative and using LED lighting (Melissen et al., 2016). Stirring a global understanding of energy vulnerability issues helps to highlight the driving factors of consumption in businesses. One way to achieve economic growth without hurting the environment is for energy and environmental policies to be structured to target increased energy use efficiency (Rafindadi & Usman, 2019).

Waste Generation

Waste is generally termed as unwanted materials presented in solid, liquid and gaseous or radioactive states, however, waste is subjective since waste to one person might not be waste to another (Singh et al.

(2014). Muzenda (2014) is of the opinion that waste are unavoidable by-product from human activities. While Jasch (2009) present waste as a material, purchased and paid for but ends up as an unmarketable product. Many issues raised on the amount and impact of waste on the environment has propelled managers in different industries to reconsider their processes and activities (Tajelawi, 2016). Waste goes into dumpsite, taking up land space, while toxic gases are emitted as a result of waste from landfill sites. Hotel kitchens generate food waste, which is categorised as organic waste (Katherine Leanne Christ & Burrirt, 2017). Food waste in the service industry is linked with greenhouse gases (GHG) emitted from the methane released from the landfill sites (Michalec, Fodor, Hayes, & Longhurst, 2018). Hotels are regarded as significant contributors to GHG emissions. They generate a huge amount of wet wastes (e.g. garden waste, food waste and cooking oil waste) and dry waste (e.g. cardboard, plastics, cans/metal, linen, paper and other garbage) that is transferred into landfills (Abdou et al., 2020). A typical hotel releases an average of 20.6kg of CO₂ per hotel per night and produces at least 1kg of waste per customer per day. The costs of waste continue to rise, yet it is not just the cost that needs to be reflected on, but much more significant is the cost associated with the wasted resources discarded.

THE EMERGENCE AND CRITERIA FOR GREEN HOTELS

Green hotels emerged in the 1990s when environmentalism began to burgeon, at a time when consumers increasingly became concerned about environmental issues such as global warming, ozone depletion and ecological damage (Lee, Hsu, Han, & Kim, 2010). The green hotel concept is designed consistently to achieve sustainable development, which is used to clarify the hotel's direction in terms of environmental protection and environmental management (Duan, 2019). Green hotels developed as one of the most significant innovations of the tourism industry planned to use products and services that minimise water and energy consumption and reduce solid waste generation to prevent the depletion of natural resources, thereby protecting the environment (Teng, 2011). While the hotels' motivation in environmental issues originated as a cost-benefit perspective (Hsieh, 2012), green hotel practices have contributed to reducing operational costs and increasing hotels' profits, enhancing guest satisfaction and loyalty, sustaining the environment, and gaining a competitive advantage (Abdou et al., 2020). Businesses use green practices to achieve a sustainable competitive advantage since green practices play a critical role in establishing a positive brand image and meeting customers' demands (Okumus, Köseoglu, Chan, Hon, & Avci, 2019). Going green is popularly used as a marketing strategy to attract customers, given that over the years, hotel guests have become increasingly aware of environmental issues. A green hotel image positively affects customers' perceptions, thereby increasing guests' revisit intentions for future stay (Yi, Li, & Jai, 2018).

GREEN MANAGEMENT IN HOTEL BUSINESS

Green practices in the hospitality industry evolved over a decade ago and continue to grow in importance and significance (Kim, Lee, & Fairhurst, 2017). Unfortunately, the industry's acclaimed green image is often without a proper understanding of what green means. Despite the many opportunities available to incorporate green practices, many managers remain uncertain about investing in green initiatives. However, as the sector faces diverse pressure from forces such as consumer demand, increasing environmental regulation, managerial concern with ethics, customer satisfaction and maintenance issues

Material Flow Cost Accounting (MFCA)

related to the physical plant and the need for aesthetics (Ijasan, Ajibola, & Gaibee, 2016) managers are now forced to re-think. Sustainability, of which green management is a subsidiary, is currently one of the top priorities of the hospitality industry globally (Scholz, 2016a). Green management is defined by Oleskow-Szlapka et al. (2011) as the process and practice introduced by businesses for reducing, eliminating and preventing adverse environmental effects arising from their activities. This process indicates that hotel businesses should make a conscious effort to reduce their impact on the environment and map out pathways to achieve it. Although the hospitality industry does not pollute the environment as severely or consume vast amounts of non-renewable resources compared to other industries in the manufacturing industry, its resource consumption still has a global impact (Rogerson & Sims, 2012). Green management practices provide firms with supplementary information sources that can enhance their business and environmental objectives (Khan, 2018). While green practices in the hospitality industry have been explored from several views, the three primary justifications identified were financial benefits, consumer demand and stakeholder relations (Kim et al., 2017).

THE EMERGENCE OF ENVIRONMENTAL MANAGEMENT ACCOUNTING (EMA), BENEFITS AND ITS ROLE IN THE HOTEL BUSINESS

Environmental management (EM) is a broad term that covers issues such as environmental impact, sustainability, resource management and pollution, and is something that has given most businesses a wake-up call to their social responsibilities in the last decade. EM dates back at least 40 years to the post-war years when the expansion of industries was seen to cause harm to the environment and people's health. EM in the hotel business emerged as compliance with environmental responsibility in business policies and strategies, in the effort to decrease their impact on the environment and comply with environmental laws and regulations, reduce costs, improve reputation and ensure the competitiveness and business viability (Janković & Krivačić, 2014). However, most managers are saddled with resolving environmental policies (Hsiao, Chuang, Kuo, & Yu, 2014), thereby creating resource management pressure. Stakeholders for organisations also mount pressure to adopt cleaner and safer environmental practices giving rise to accounting practice intervention referred to as Environmental Management Accounting (Sands, Lee, & Gunarathne, 2015). Since businesses are now assessed not only on their financial performance but also on their environmental responsibilities, managers' duties towards a strategic EM approach became a mammoth task. Managers require the EMA concept for corporate environmental strategies to support EM planning to help stakeholders obtain clear, detailed information on environmental performance for decision-making purposes (Amiruddin, 2016). EMA comprises of the identification, collection, analysis and use of a broad scope of information for internal decision-making, physical information on the use and flows of energy, water and materials (including waste), financial information on environment-related costs, earnings and savings, hidden/indirect environmental information in overheads and future periods and external information which is transmitted outside the assumed, legitimate and "usual" boundary of an organisation (Qian, Burritt, & Monroe, 2011). EMA arose as an interface between management accounting and environmental accounting due to the rising concern relating to the environment (Gunarathne & Lee, 2013). Environmental accounting is imperative given that businesses are expected to convey environmental protection activities to their stakeholders (Amiruddin, 2016). The element of EMA is a pivotal tool not only focused on managing the environment, but incorporates improvement of planning processes to efficiently allocate and control costs, improved pricing strategies and to effec-

tively evaluate performance (Nyide, 2016a). The EM strategies of hotels have been implemented with consistent commitment and analytically assessed with the support of the EMA system; the strategies are interwoven with EMA practices to include accounting for material, energy, environmental impact assessment, life-cycle design and more (Sands et al., 2015). Research conducted in EMA is founded on the view that businesses' non-productive output has consequences elsewhere, signifying incompetent processes (Gale, 2006). Thus, managers' inability to analyse their operations about the non-productive output and costs incurred indicates a negative impact on productivity (Fakoya & van der Poll, 2013). As businesses attempt to satisfy investors by reducing their actions on the environment, innovative approaches that are beneficial in meeting managers' sustainability challenges have become apparent (Katherine L Christ & Burritt, 2013). Diverse EMA tools that support green management have been suggested for waste prevention or minimisation strategies due to the conventional accounting method's deficiencies to reveal hidden costs in the overhead accounts not recorded by this method (Tsai et al., 2012). Most of the EMA tools proposed have focused mainly on the manufacturing industry (Fakoya & van der Poll, 2013; Nyide & Lekhanya, 2016). However, studies have reported some successful adoption of EMA in the hospitality industry.

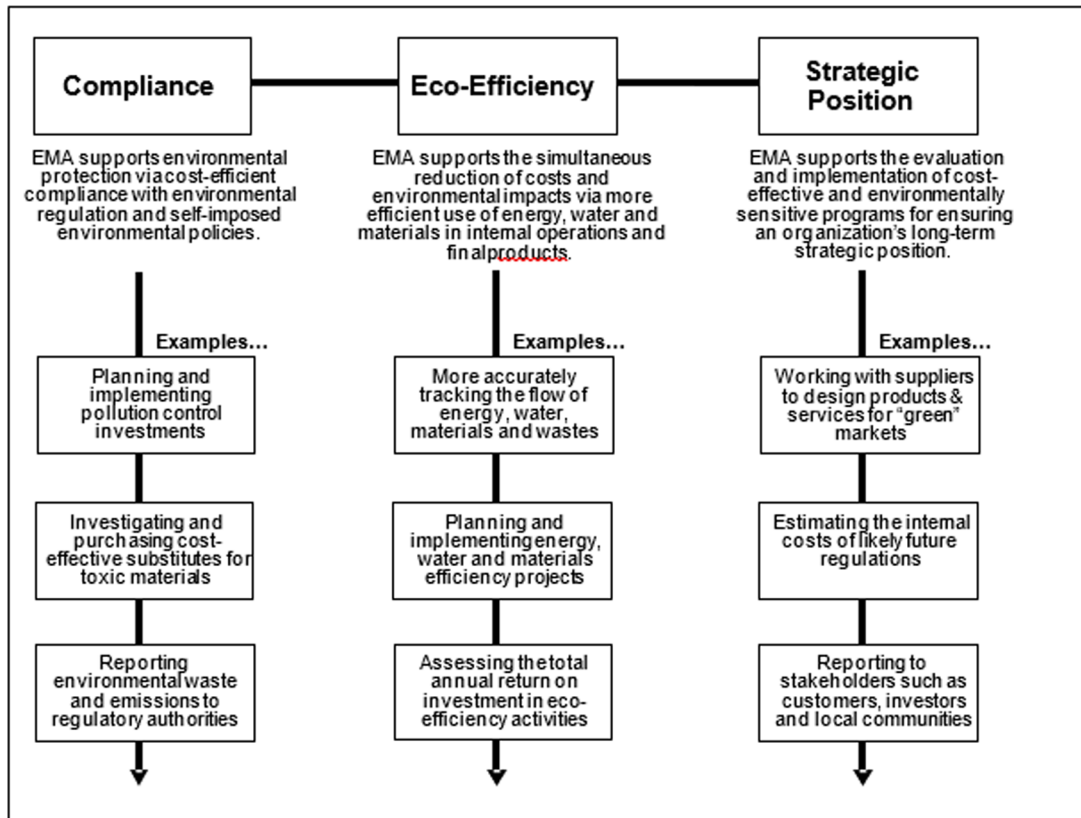
THE USE AND BENEFITS OF EMA IN THE HOTEL BUSINESS

The International Federation of Accountants (IFAC) in the 2005 International Guidance Document on Environmental Management Accounting, provided a visual of how EMA can benefit a business - indicating its relevance as both an internal and external reporting tool covering three extensive categories: compliance, eco-efficiency and strategic position (Savage & Jasch, 2005) as shown in Figure 2. Different businesses have the liberty to adopt EMA according to their strategic business focus. The three categories flow into one another, for example, a hotel that reduces its water consumption invariably reduces the wastewater generated and assigned for treatment through eco-efficiency schemes and compliance resolution. EMA integrates environmental costs into conventional reports, creating a basis for business process thereby highlighting the effectiveness and efficiency of resource usage in the process (Agustia, Sawarjuwono, & Dianawati, 2019).

An environmentally responsible hotel can be described as one that conducts its activities to reduce its impact on the environment via the reduction of non-renewable natural resources, the reduction of its emission, its investment in green technology and training and creation of environmental awareness among its employees. Compliance with environmental regulation obligates hotels to implement and comply with environmental standards and disclose environmental management information. Considering it is required that information on environmental costs and other environmental performance be communicated to stakeholders (Janković & Krivačić, 2014), disclosure practices in business are noted to support legitimacy and stakeholder theory (Debnath, Bose, & Dhalla, 2011). Legitimacy theory anchors on the norm that the performance of a business is not only measured by its profits but also its social performances; while the stakeholders' theory considers stakeholders' expectations on business strategy (Amiruddin, 2016). Businesses operate in an environment with expectations from both the business stakeholders and the community at large. According to IFAC (2005), EMA can help businesses comply with environmental legislations via environmental accounting disclosure of environmental impact in financial statements and simultaneously ensure communication to stakeholders. However, Saleh, Jawabreh, Alsarayreh, and Malkawi (2018) observed that hoteliers and hotel managers' challenges are that the issuance of financial

Material Flow Cost Accounting (MFCA)

Figure 1. Uses and benefits of EMA (IFAC 2005)



statements or the release of the hotels' social assets does not improve the turnover or the image of the hotel. Hence, the conflict of interest. Nonetheless, country-specific legislation is noted to significantly affect hotel compliance with accounting standards (Saleh et al., 2018). The awareness of EMA in the hotel sector is still primarily limited, although its adoption in hotels is less complicated and low on costs, is designed to assist hotels trail and decrease their energy and water consumption and costs and manage waste (Nyide, 2019). However, very few hotels, particularly in developed countries, have demonstrated a high level of awareness and adoption of EMA practices as a green tool. For the few cases reported, EMA was integrated into the hotel management system to improve environmental performance. The EMA tools utilised to achieve this aim were environmental impact assessment, life-cycle design and MFCA (Gunarathne & Lee, 2013; Nyide, 2019). EMA focuses explicitly on material and energy flow and environmental cost information, giving credence to resource management eco-efficient ways. Hotels' commitment to eco-environmentalism is reflected in an accounting information system that includes emissions, water use and wastewater, energy use, solid waste management, noise emission and health hazards in chemical handling (Jankovic, Persic, & Zanini, 2011). Common goals inherent to the hotel business are attributed to creating conditions in the EMA system to enable eco-efficiency measurement, a continuous process of change applied to reduce environmental impacts with an enhanced value for products and services (Jankovic et al., 2011). Energy saving is a strategic avenue for response to climate

and sectorial green growth policy focus in hotels; adopting an EMA-based energy-saving characterisation framework was found to counter the challenges associated with unreliable benefits of energy saving (Machete, Hongoro, Nhamo, & Mearns, 2016). EMA has been used in the hotel business to measure and collect physical and monetary water and waste information (Dissanayake, Herath, & Thanthree, 2014), improve economic performance by improving resource efficiency and waste management (Nyide, 2019), create environmental protection and improvement via high quality of environmental accounting information managerial decision-making process (Jankovic et al., 2011), allow hotels to estimate the environmental cost of solid waste and show the simplicity of the inclusion of environmental costs (W. W. Chan & Lam, 2001). It also transforms into a green hotel when faced with financial crisis (Gunaratne & Lee, 2013), reduces pollution and becomes eco-friendly and is able to publicly disclose environmental impact (Saleh et al., 2018) and improve environmental responsibility (Janković & Krivačić, 2014). The benefits derived from EMA in the hotel business is still an ongoing discovery. The environmental costs within EMA include Environmental Protection Expenditure (EPE) and monetary information for cost-effective environmental management performance (Jasch, 2009). Another EMA tool capable of providing both physical and monetary information is known as material flow cost accounting (Jasch, 2009).

THE HISTORICAL DEVELOPMENT AND CONCEPT OF MATERIAL FLOW COST ACCOUNTING

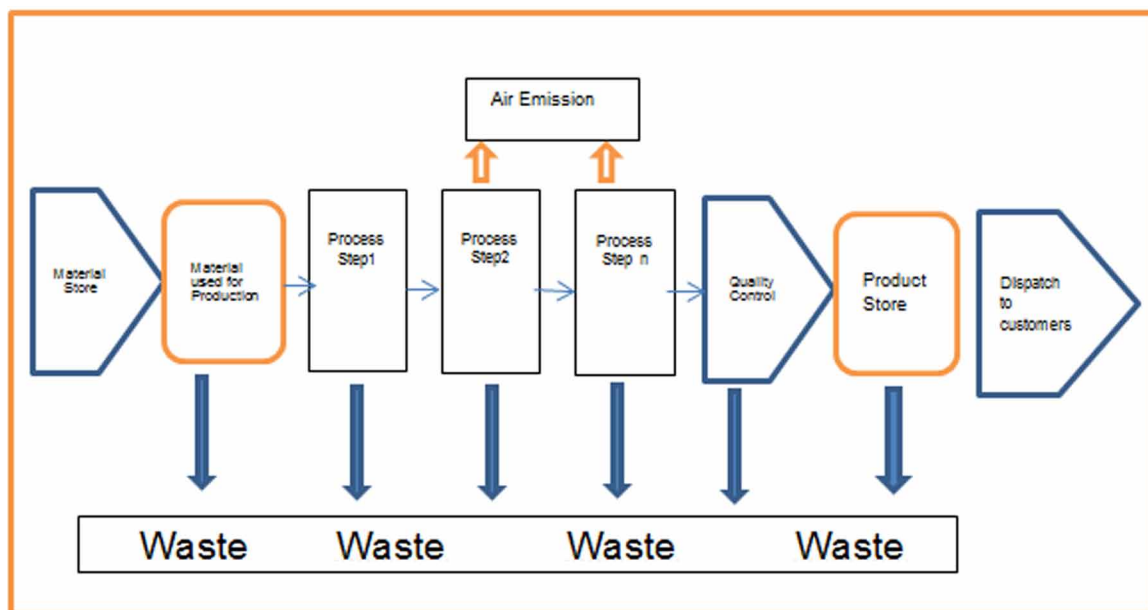
MFCA is an EMA tool that is widely adopted and has proffered environmental solutions in manufacturing industries (Fakoya & van der Poll, 2013; Jasch, 2009; Shahbazi, Wiktorsson, Kurdve, Jönsson, & Bjelkemyr, 2016). Among the various existing environmental management accounting tools, MFCA stands as one of the most promising to the service industry. MFCA is considered a suitable EMA tool to improve resource productivity, assisting in increasing transparency by visualising material flows with the associated costs and internalised impact (Rieckhof, Bergmann, & Guenther, 2015). The objective of MFCA is to identify potentials for monetary savings by avoiding unnecessary wastes, residual substances, emissions and generally all non-productive energy and material flows (Schmidt, 2015). MFCA originated from Augsburg in Germany, where Bernd Wagner and colleagues initiated it at the Institut für Management und Umwelt (IMU) but refined by the Japanese in the 1990s (Tajelawi, 2016). The concept of MFCA is based on the fundamental assumption that every material purchased by a business must eventually exit as either part of the final product or as waste (Katherine Leanne Christ & Burritt, 2017). The International Standard for Organisation (ISO 14051) published MFCA as a management tool to help businesses better understand the potential environmental and financial consequences of their material and energy use practices and seek opportunities to achieve both environmental and financial improvements via changes in these practices. Historically, most managers have assumed that improving environmental performance represents only extra costs to a firm without corresponding benefits rather than to ensure compliance with laws and regulations, thereby preventing fines and prosecutions (Schaltegger, Bennett, Burritt, & Jasch, 2008).

On the contrary, MFCA is beneficial for businesses that want to increase their sustainability, mainly by reducing the impact of waste, minimising inefficient use of materials and energy and reducing the businesses' financial costs (Ulupui et al., 2020). MFCA is cost-effective and does not require expensive software (Katherine Leanne Christ & Burritt, 2017). Authors have argued that the information gained from the adoption of MFCA can act as a motivator for businesses and managers seeking opportunities

Material Flow Cost Accounting (MFCA)

to simultaneously generate financial benefits by improving material efficiency, simultaneously reducing material costs and adverse environmental impacts (Katherine Leanne Christ & Burritt, 2017; Schaltegger & Zvezdov, 2015). Others have described MFCA as a tool that reconciles the environment and the economy (Kokubu & Kitada, 2015). MFCA depends on the access to matching physical information, but explicitly on materials and energy flows and is frequently categorised as past-oriented from a short-term management perspective. Since information on both quantity and costs is needed by managers, MFCA is a likely tool to provide such information.

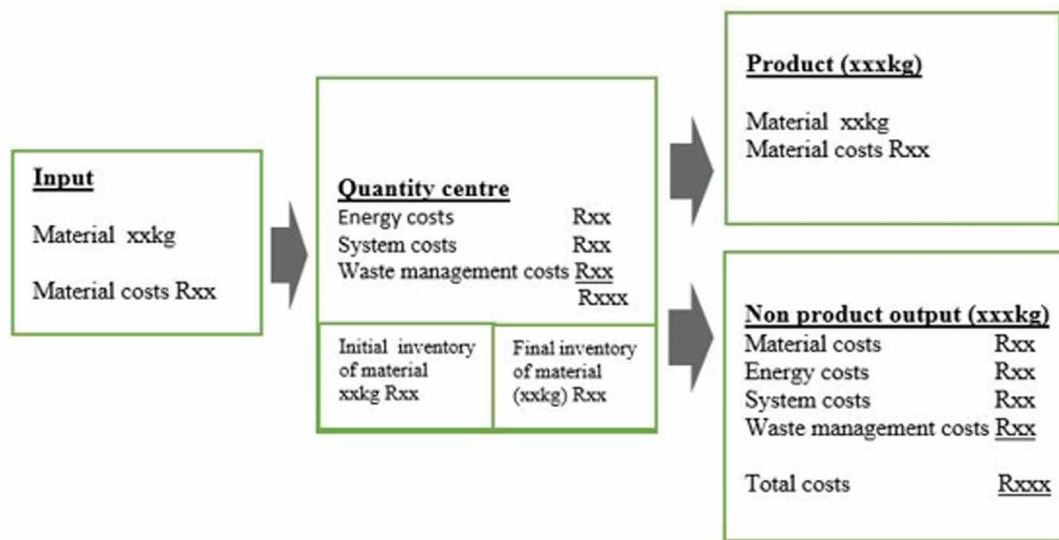
Figure 2. Material flow from input stage to output (Tajelawi 2016)



In setting up the MFCA model, the boundary which the model will cover is determined. The boundary can be set at the business level or further divided according to locations, cost centres, processes and product levels (Jasch, 2006). The uniqueness of MFCA rests on the allocation of all process costs on either the planned output (product) or the unplanned output (wastes generated from the process steps) (Walz & Günther, 2020). The central idea of MFCA is geared towards highlighting inefficiencies in a process that leads to losses (Kokubu & Kitada, 2015). Through the improvement of process inefficiencies, less waste is generated and sent to landfills, thereby reducing pollution. Less cost is also incurred for waste management purposes, thereby improving cost savings and financial performance. Figure 2 shows a representation of the application of the MFCA model. The physical flow of materials in the process is demonstrated through different stages of the process, from the input to the output stage, where the final product is produced (Marota, 2017). Waste and emissions generated at different stages of the process are identified and collected. The system provides a transparent view of resource input flows through each step of the process until the end. MFCA regards the relevant flows as cost collectors and uses the information to allocate the business operations costs. Within the MFCA model, input material that goes into the system is categorised as raw material (which becomes part of the final product), auxiliary ma-

materials (which become part of the product and are considered as the main components) and operating materials (consumed as part of the input process but not included in the final product) which end up as part of wastewater and emission (Dunuwila, Rodrigo, & Goto, 2020; Jasch, 2009; Tajelawi, 2016). It is imperative to note that a transparent view of a business process reveals the stages where inefficiencies are inherent and financial leakages can be prevented. MFCA applies to all kinds of businesses that use materials and energy regardless of their products, services, size, location, management and accounting systems (Katherine Leanne Christ & Burritt, 2017).

Figure 3. Representation of material flow cost accounting principle (Adapted from ISO 14051)



Five stages guide the implementation of MFCA according to the International Organizations for Standardization (ISO) 14051: (1) engaging management and determining roles and responsibilities, (2) identifying scope and boundary of the process and establishing a material flow model, (3) allocating costs (material cost, energy cost, system cost and waste management cost), (4) interpreting and communicating MFCA results, and (5) improving production practices and reducing material loss through MFCA results (Tran & Herzig, 2020).

IMPLEMENTATION OF MFCA IN THE HOTEL BUSINESS

MFCA is a potentially beneficial tool for hotel businesses. Identifying the potential of MFCA in the hotel business first defines the system boundaries and resources consumed in its process. Since MFCA can be scaled up to cover the entire hotel or scaled down to cover a part of the hotel, it means the hotel can identify inefficiencies at either a small or large scale depending on the process's size. The application of MFCA requires the hotel management's support as a high relevance of the strategic decision-making process is needed (Tran & Herzig, 2020). Given the shortage of the implementation of MFCA in hotels,

Material Flow Cost Accounting (MFCA)

this chapter has adopted Katherine Leanne Christ and Burritt (2017) model. In a food service sector, the three quantity centres frequently required to set the boundary are storage preparation and service, energy and system costs. The implementation of MFCA lies in the indirect costs on the leftover food on the customer's plate that has been wasted, such as energy costs, kitchen and storage costs, energy costs of machinery, refrigerators and freezers, labour or preparation costs, depreciation costs, kitchen equipment costs, wasted cost on rental storage and kitchen areas allocated to wasted output. Emphasising the actual cost of waste assigned to non-product output is a motivation for managers who are frequently profit-driven on resource management. With more care on material usage, the economic and environmental performance of the business is improved (Katherine Leanne Christ & Burritt, 2017), thereby enhancing the green image of the business. However, the challenges and barriers to the successful implementation of MFCA in businesses have been attributed to the availability of data and data accuracy (Tran & Herzig, 2020).

LINKING MFCA AS A GREEN MANAGEMENT TOOL FOR A SUSTAINABLE HOTEL BUSINESS

Green practices in the hotel business predominantly include saving energy, reducing water consumption and reducing waste management (Abdou et al., 2020). There are many reasons hotel managers should encourage green management and prioritise resource utilisation in the hospitality industry. Not only is waste placing a considerable strain on the environment, with the costs of raw materials, water and energy usage and with waste disposal continuously on the rise as more resources are consumed, the pressure will also mount on the financial bottom line (Katherine Leanne Christ & Burritt, 2017). The hotel business from now on needs practical green management tools that will help manage the issues of apprehension in the industry. How can managers incorporate MFCA as a GMT in the hotel business? Firstly, a business process's performance should be based on efficiency and effectiveness (Marota, 2017). The nature and attributes of MFCA are focused on enhancing efficiency and effectiveness. Through the concept of MFCA, activities in the process are improved to achieve cost-effectiveness (water and energy), reduce material losses and improve environmental performances by reducing waste generated in the process by managing activities in the quantity centres. Although MFCA has been minimally adopted in the hotel business, the contributions are without doubt beneficial to the service sector. MFCA has been used to reduce food waste in restaurants and hotels (Katherine Leanne Christ & Burritt, 2017) and has significantly influenced business sustainability (Marota, 2017), enhanced cost performance and reduced environmental damage (Walz & Günther, 2020). It has successfully introduced the concept of environmental consciousness (Nakajima, 2010), and improved raw material, energy and system efficiency (Hakimi et al., 2020) in other industries.

Incorporating MFCA into the hotel process, such as the food production in the kitchen, energy and the system costs can be ascertained as an incentive for remedial action. As indicated above, the success stories of MFCA have predominantly been in the manufacturing sectors and are sparsely adopted in the service industry, however, few applications reported cases in the service sector (Katherine Leanne Christ & Burritt, 2017; Nyide, 2016b). The cost-effectiveness of applying MFCA is a way for struggling hotels to recoup losses by reducing environmental costs and maintaining their social, environmental responsibilities. When waste that goes to landfill sites from the hotel kitchens is reduced, cost incurred within the system and its impact on the environment are reduced. The elements of green management focus on

managing economic and social activities' communication and education of employees and guests, management, waste management, energy savings and water savings (Scholz, 2016b) to achieve eco-friendly activities. While MFCA assists the manager in accomplishing the desired eco-friendly objectives via improvement of resource consumption in a process. It can be observed that both are targeted towards ensuring a safe environment and economic improvement for the industry.

CONCLUSION

This chapter describes the potentials of using MFCA as a green management tool in the hotel business. The concept and characteristics of MFCA were presented with examples from both the manufacturing and hospitality industries. Furthermore, green management within the hotel business was also given from different authors' perspectives. Green management introduces processes and practices for reducing, eliminating, and preventing adverse environmental effects arising from their activities. The principle and application of MFCA in the hotel business revealed a significant influence on hotels' business processes based on the MFCA principle. Seeing that the costs of resources are on the rise and the strain of their disposal as waste could be burdensome, it is evident that the environment will not only be impacted, financial losses could also be incurred (Katherine Leanne Christ & Burritt, 2017). The success of MFCA adoption in the manufacturing industry can be replicated in the hospitality industry since the technique involves the use of resources in a process and promotes efficiency in the process. Although greening in hotels has paid more attention to customers' and stakeholders' perception in structuring eco-friendly activities, adopting efficient and effective environmental tools promotes eco-friendly activities and financial performance. The chapter also revealed that MFCA and GMT are targeting the same objectives.

FUTURE RESEARCH

The hospitality industry needs environmental management intervention via environmental management tools like MFCA to attain eco-friendly objectives. Conducting more research in the tourism and hospitality industry regarding the application of MFCA is still a grey area that should be explored. There are different hospitality industry processes that MFCA can adopt to propagate and encourage eco-friendly practices.

RECOMMENDATION

It is difficult to determine how many hotels are aware of the potentials of applying MFCA or are knowledgeable and not ready to adopt it as a practice despite the prospects and success stories reported. However, many businesses in the service sector are still unaware of MFCA, which is a likely tool to improve the environmental performance of the service sector. The chapter established that GM and MFCA are targeting common goals. Most times, businesses are plagued with the inability to evaluate the correct amount and cost of losses generated in their processes. More research should be conducted to explore the resourcefulness of MFCA in the service sector. MFCA could be modified to adapt the information in the service sector to reduce environmental impact on the industry.

REFERENCES

- Abdou, A. H., Hassan, T. H., Dief, E., & Moustafa, M. (2020). A Description of Green Hotel Practices and Their Role in Achieving Sustainable Development. *Sustainability*, *12*(22), 9624.
- Abdulredha, M., Al Khaddar, R., Jordan, D., Kot, P., Abdulridha, A., & Hashim, K. (2018). Estimating solid waste generation by hospitality industry during major festivals: A quantification model based on multiple regression. *Waste Management (New York, N.Y.)*, *77*, 388–400.
- Agustia, D., Sawarjuwono, T., & Dianawati, W. (2019). The mediating effect of environmental management accounting on green innovation-Firm value relationship. *International Journal of Energy Economics and Policy*, *9*(2), 299–306.
- Amiruddin, G. P. (2016). Environmental management accounting: Identifying future potentials. *Asia-Pacific Management Accounting Journal*, *11*(1), 80–94.
- Aragon-Correa, J. A., Martin-Tapia, I., & de la Torre-Ruiz, J. (2015). Sustainability issues and hospitality and tourism firms' strategies. *International Journal of Contemporary Hospitality Management*.
- Cerchione, R., & Bansal, H. (2020). Measuring the impact of sustainability policy and practices in tourism and hospitality industry. *Business Strategy and the Environment*, *29*(3), 1109–1126.
- Chan, E. S., Okumus, F., & Chan, W. (2020). What hinders hotels' adoption of environmental technologies: A quantitative study. *International Journal of Hospitality Management*, *84*, 102324.
- Chan, W. W., & Lam, J. (2001). Environmental accounting of municipal solid waste originating from rooms and restaurants in the Hong Kong hotel industry. *Journal of Hospitality & Tourism Research (Washington, D.C.)*, *25*(4), 371–385.
- Christ, K. L., & Burritt, R. (2017). Material flow cost accounting for food waste in the restaurant industry. *British Food Journal*, *119*(3), 600–612.
- Christ, K. L., & Burritt, R. L. (2013). Environmental management accounting: The significance of contingent variables for adoption. *Journal of Cleaner Production*, *41*, 163–173.
- Debnath, S., Bose, S., & Dhalla, R. (2011). Environmental Management Accounting: An Overview of its Methodological Development. *International Journal of Business Insights & Transformation*, *5*(1).
- Dissanayake, D., Herath, N., & Thanthree, P. (2014). *Managing Waste and Water with the Help of Environmental Management Accounting (EMA): A Sri Lankan Hotel Sector Case*. Academic Press.
- Donnenfeld, Z., Hedden, S., & Crookes, C. (2018). *A delicate balance: Water scarcity in South Africa*. Academic Press.
- Duan, W. (2019). *An analysis of the development of "green" hotels in a small to medium-sized city-Kunming*. Auckland University of Technology.
- Dunuwila, P., Rodrigo, V., & Goto, N. (2020). Improving financial and environmental sustainability in concentrated latex manufacture. *Journal of Cleaner Production*, *255*, 120202.

- Edoun, E., Mbohwa, C., & Bhila, M. T. Y. (2019). The impact of waste management in the hospitality industry Johannesburg north. Academic Press.
- Fakoya, M. B., & van der Poll, H. M. (2013). Integrating ERP and MFCA systems for improved waste-reduction decisions in a brewery in South Africa. *Journal of Cleaner Production*, *40*, 136–140.
- Fuentes-Moraleda, L., Lafuente-Ibáñez, C., Muñoz-Mazón, A., & Villacé-Molinero, T. (2019). Willingness to pay more to stay at a boutique hotel with an environmental management system. A preliminary study in Spain. *Sustainability*, *11*(18), 5134.
- Gale, R. (2006). Environmental management accounting as a reflexive modernization strategy in cleaner production. *Journal of Cleaner Production*, *14*(14), 1228–1236.
- Graci, S., & Kuehnel, J. (2011). *How to increase your bottom line by going green*. Green Hotels & Responsible Tourism Initiative.
- Gunarathne, N., & Lee, K. (2013). *Adopting and Implementing Environmental Management Accounting (EMA) Practices in the Hotel Sector: A Sri Lankan Case*. Paper presented at the A paper presented at the EMAN Global Conference, Gold Coast, Queensland.
- Hakimi, A., Abedi, Z., & Dadashian, F. (2020). *Increasing Energy and Material Consumption Efficiency by Application of Material and Energy Flow Cost Accounting System (Case Study: Turbine Blade Production)*. Academic Press.
- Hsiao, T.-Y., Chuang, C.-M., Kuo, N.-W., & Yu, S. M.-F. (2014). Establishing attributes of an environmental management system for green hotel evaluation. *International Journal of Hospitality Management*, *36*, 197–208.
- Hsieh, Y. C. J. (2012). Hotel companies' environmental policies and practices: A content analysis of their web pages. *International Journal of Contemporary Hospitality Management*.
- Huang, S. Y., Chiu, A. A., Chao, P. C., & Wang, N. (2019). The Application of Material Flow Cost Accounting in Waste Reduction. *Sustainability*, *11*(5), 1270.
- Ijasan, K., Ajibola, M., & Gaibee, K. (2016). The Case For Green Hotels: An Investigation Into The Outlook Of South African Business Travellers. *International Journal of Applied Environmental Sciences*, *11*(3), 809–824.
- Janković, S., & Krivačić, D. (2014). Environmental accounting as perspective for hotel sustainability: Literature review. *Tourism and Hospitality Management*, *20*(1), 103–120.
- Jankovic, S., Persic, M., & Zanini, G. T. (2011). Framework for development of environmental management accounting in Croatian hospitality industry. *Sustainable Tourism: Socio-Cultural, Environmental and Economics Impact*, 121-135.
- Jasch, C. (2006). How to perform an environmental management cost assessment in one day. *Journal of Cleaner Production*, *14*(14), 1194–1213.
- Jasch, C. (2009). *Environmental and Material Flow Cost Accounting: Principles and Procedures* (Vol. 25). Academic Press.

Material Flow Cost Accounting (MFCA)

- Khan, S. A. R. (2018). Introductory chapter: introduction of green supply chain management. In *Green Practices and Strategies in Supply Chain Management*. IntechOpen.
- Kim, S.-H., Lee, K., & Fairhurst, A. (2017). The review of “green” research in hospitality, 2000-2014. *International Journal of Contemporary Hospitality Management*.
- Kokubu, K., & Kitada, H. (2015). Material flow cost accounting and existing management perspectives. *Journal of Cleaner Production*, 108, 1279–1288.
- Lee, J.-S., Hsu, L.-T., Han, H., & Kim, Y. (2010). Understanding how consumers view green hotels: How a hotel’s green image can influence behavioural intentions. *Journal of Sustainable Tourism*, 18(7), 901–914.
- Machete, F., Hongoro, C., Nhamo, G., & Mearns, K. (2016). The use of environmental accounting to determine energy saving in Mpumalanga Hotels. Academic Press.
- Marota, R. (2017). Green concepts and material flow cost accounting application for company sustainability. *Indonesian Journal of Business and Entrepreneurship*, 3(1), 43–43.
- Mbaser, M., Du Plessis, E., Saayman, M., & Kruger, M. (2016). *Environmentally-friendly practices in hotels* (Vol. 16). Academic Press.
- Melissen, F., Cavagnaro, E., Damen, M., & Düweke, A. (2016). Is the hotel industry prepared to face the challenge of sustainable development? *Journal of Vacation Marketing*, 22(3), 227–238.
- Merli, R., Preziosi, M., Acampora, A., & Ali, F. (2019). Why should hotels go green? Insights from guests experience in green hotels. *International Journal of Hospitality Management*, 81, 169–179.
- Michalec, A., Fodor, M., Hayes, E., & Longhurst, J. (2018). Co-designing food waste services in the catering sector. *British Food Journal*.
- Muzenda, E. (2014). *A discussion on waste generation and management trends in South Africa*. Academic Press.
- Nakajima, M. (2010). *Environmental Management Accounting for Sustainable Manufacturing: Establishing Management System of Material Flow Cost Accounting*. MFCA.
- Nyide, C. J. (2016a). *A critical evaluation of environmental management accounting (EMA) tools used by 3-5 star hotels in KwaZulu-Natal*. Academic Press.
- Nyide, C. J. (2016b). *Material flow cost accounting as a tool for improved resource efficiency in the hotel sector: a case of emerging market*. Academic Press.
- Nyide, C. J. (2019). Better resource management: A qualitative investigation of Environmental Management Accounting practices used by the South African hotel sector. *African Journal of Hospitality, Tourism and Leisure*, 8(4). https://www.ajhtl.com/uploads/7/1/6/3/7163688/article_56_vol_8_4__2019_dut.pdf
- Nyide, C. J., & Lekhanya, L. M. (2016). *Environmental management accounting practices: major control issues*. Academic Press.

- Okumus, F., Köseoglu, M. A., Chan, E., Hon, A., & Avci, U. (2019). How do hotel employees' environmental attitudes and intentions to implement green practices relate to their ecological behavior? *Journal of Hospitality and Tourism Management*, 39, 193–200.
- Qian, W., Burritt, R., & Monroe, G. (2011). Environmental management accounting in local government: A case of waste management. *Accounting, Auditing & Accountability Journal*.
- Rafindadi, A. A., & Usman, O. (2019). Globalization, energy use, and environmental degradation in South Africa: Startling empirical evidence from the Maki-cointegration test. *Journal of Environmental Management*, 244, 265–275.
- Rieckhof, R., Bergmann, A., & Guenther, E. (2015). Interrelating material flow cost accounting with management control systems to introduce resource efficiency into strategy. *Journal of Cleaner Production*, 108, 1262–1278.
- Rogerson, J. M., & Sims, S. R. (2012). *The greening of urban hotels in South Africa: Evidence from Gauteng*. Paper presented at the Urban forum.
- Saleh, M. M. A., Jawabreh, O. A., Alsarayreh, M. N., & Malkawi, E. (2018). Environmental accounting as perspective for hotels of Aqaba special economic zone authority (ASEZA). *Problems and Perspectives in Management*, (16(4)), 169–185.
- Sands, J., Lee, K.-H., & Gunarathne, N. (2015). Environmental Management Accounting (EMA) for environmental management and organizational change. *Journal of Accounting & Organizational Change*.
- Savage, D., & Jasch, C. (2005). *International guidance document on environmental management accounting*. IFAC.
- Schaltegger, S., Bennett, M., Burritt, R. L., & Jasch, C. (2008). *Environmental management accounting for cleaner production*. Academic Press.
- Schaltegger, S., & Zvezdov, D. (2015). Expanding material flow cost accounting. Framework, review and potentials. *Journal of Cleaner Production*, 108, 1333–1341.
- Schmidt, M. (2010). Approaches towards the Efficient Use of Resources in the Industry. *Chemical Engineering & Technology: Industrial Chemistry-Plant Equipment-Process Engineering-Biotechnology*, 33(4), 552–558.
- Schmidt, M. (2015). The interpretation and extension of Material Flow Cost Accounting (MFCA) in the context of environmental material flow analysis. *Journal of Cleaner Production*, 108, 1310–1319.
- Scholz, P. (2016a). *Ekonomické aspekty uplatňování environmentálního managementu na příkladu hotelů třídy luxury v české republice economic aspects of implementation of environmental management on an example of luxury class hotels*. Paper presented at the Hradecké ekonomické dny 2015, Milano, Italy.
- Scholz, P. (2016b). *Green Management Implementation in Accommodation Facilities in Slovakia*. Academic Press.

Material Flow Cost Accounting (MFCA)

- Shahbazi, S., Wiktorsson, M., Kurdve, M., Jönsson, C., & Bjelkemyr, M. (2016). Material efficiency in manufacturing: Swedish evidence on potential, barriers and strategies. *Journal of Cleaner Production*, 127(Supplement C), 438–450.
- Shang, J., Basil, D. Z., & Wymer, W. (2010). Using social marketing to enhance hotel reuse programs. *Journal of Business Research*, 63(2), 166–172.
- Singh, N., Cranage, D., & Lee, S. (2014). Green strategies for hotels: Estimation of recycling benefits. *International Journal of Hospitality Management*, 43, 13–22.
- Singjai, K., Winata, L., & Kummer, T.-F. (2018). Green initiatives and their competitive advantage for the hotel industry in developing countries. *International Journal of Hospitality Management*, 75, 131–143.
- Styles, D., Schoenberger, H., & Galvez-Martos, J. L. (2015). Water management in the European hospitality sector: Best practice, performance benchmarks and improvement potential. *Tourism Management*, 46, 187–202.
- Sucheran, R. (2013). *Environmental management in the hotel and lodge sector in KwaZulu-Natal*.
- Tajelawi, O. A. (2016). *Using Material Flow Cost Accounting to determine the impacts of packaging waste costs in alcoholic beverage production in an alcoholic beverage company in Durban*. Department of Management Accounting, Faculty of Accounting and Informatics, Durban University of Technology.
- Teng, Y.-M. (2011). Applying the extended theory of planned behavior to predict the intention of visiting a green hotel. *African Journal of Business Management*, 5(17), 7579–7587.
- Tirado, D., Nilsson, W., Deya-Tortella, B., & Garcia, C. (2019). Implementation of water-saving measures in hotels in Mallorca. *Sustainability*, 11(23), 6880.
- Tran, T. T., & Herzig, C. (2020). Material flow cost accounting in developing countries: A systematic review. *Sustainability*, 12(13), 5413.
- Tsai, W.-H., Shen, Y.-S., Lee, P.-L., Chen, H.-C., Kuo, L., & Huang, C.-C. (2012). Integrating information about the cost of carbon through activity-based costing. *Journal of Cleaner Production*, 36, 102–111.
- Ulupui, I., Murdayanti, Y., Marini, A., Purwohedi, U., Mardia, M., & Yanto, H. (2020). Green accounting, material flow cost accounting and environmental performance. *Accounting*, 6(5), 743–752.
- Walz, M., & Günther, E. (2020). What effects does material flow cost accounting have for companies?: Evidence from a case studies analysis. *Journal of Industrial Ecology*.
- Yi, S., Li, X., & Jai, T.-M. (2018). Hotel guests' perception of best green practices: A content analysis of online reviews. *Tourism and Hospitality Research*, 18(2), 191–202.
- Yusoff, Y. M., Nejati, M., Kee, D. M. H., & Amran, A. (2020). Linking green human resource management practices to environmental performance in hotel industry. *Global Business Review*, 21(3), 663–680.
- Zaitseva, N. A., Larionova, A. A., Takhumova, O. V., Eroshenko, V. I., Lebedeva, J. A., & Stadolin, M. E. (2019). Problems and directions of application of environmental technologies in the service sector. *Ekoloji*, 28(107), 489–494.

Chapter 18

Financing Green Electricity in Nigeria for Economic Growth

Olufemi Patrick Adeyeye

 <https://orcid.org/0000-0001-6211-1564>

Federal University Oye Ekiti, Nigeria

Adekunle Alexander Balogun

Federal University Oye Ekiti, Nigeria

Oladapo Fapetu

Federal University Oye Ekiti, Nigeria

ABSTRACT

Green finance connotes the financial activities designed to aid the recovery of the environment from degradation. In Nigeria, the danger posed by solid waste to the environment is enormous. In particular, refuse collection and disposal mechanisms have not been adequately executed. The urban landscapes in the country are littered with plastics, polythene, and various non-degradable materials. In this chapter, the authors present an efficient way to clean up the Nigerian environment of solid wastes through a waste-to-energy strategy by exploring the green finance options or sources and structure to deliver renewable and clean electricity for Nigeria. The authors concluded by highlighting that green finance is useful for efficient waste management and the generation of green electricity to the Nigerian national grid.

INTRODUCTION

Green energy, otherwise known as renewable energy, is defined as energy derived from sources such as wind, solar, hydro geothermal, biomass, biofuel and other sources, which are replenished on a human timescale like geothermal heat, rain, sunlight etc. (Duru, 2014). The harm done to the environment by the non-renewable resources manifested in air and water pollution, harmful waste disposal of non-degradable substances like plastics and industrial materials, among others.

DOI: 10.4018/978-1-7998-7967-1.ch018

Financing Green Electricity in Nigeria for Economic Growth

According to the World Economic Forum (WEF, 2020), “Green finance is any structured financial activity that has been created to ensure a better environmental outcome.” Broadly, there are two ways a government can regulate green finance: by taxing emission-related activities to discourage violation and incentivize green investment by allowing tax rebates. The tax rebates given to investors on green investments is an incentive for developing economies to attract huge financing for infrastructure and growth activities. One of the biggest Nigerian developmental necessities is electricity.

Power generation is especially very crucial for industrialisation, ICT development and innovation, transportation, research and development (R&D) and other economic activities. Experts projected that with the estimated population of Nigeria of about 200 million, the country would need over 100,000 megawatts (mw) of electricity supplied from the national grid to be able to build the economy it deserves (Osueke & Ezech, 2011; Association of Nigerian Electricity Distribution Companies, 2016). About 55 per cent of the Nigerian population is not connected to the national grid of electricity, while the connected part lacks constant and regular power supply (Advisory Power Team, Office of the Vice President of Nigeria & Power Africa, 2015).

The highest electricity generated by all the power plants in Nigeria is a little above 7,000mw, while total installed capacity is about 12,500mw (Ukoima & Ekwe, 2019; PwC, 2016). Nigerians, over the years, have resorted to generating their own power by acquiring petrol/diesel powered generating sets to power their homes and businesses. This arrangement has proven to be inefficient due to the attendant financial and environmental costs. The non-renewable nature of the fuel makes it hazardous to human health and the environment. Many of the households in cities and suburban areas lack financial capacity to acquire high-capacity generating sets thereby settling for small-capacity ones. The consequent proliferation results into high noise pollution and increased carbon emission through smoke. The renewable systems that are being introduced are marketed as alternatives to the environmentally hazardous generating sets, such as public electricity-powered as well as solar-powered inverter systems for homes and wind-powered turbine systems for industrial and public generation, are pricey, beyond the reach of average consumers.

The issue of inadequate public power generation is linked to obsolete laws and regulations concerning grid management, inadequate power plants and non-renewable power generation systems such as the gas-powered plants currently being used across the country.

STATEMENT OF THE PROBLEM

Nigeria, like most developing countries around the world, is confounded with intractable problem of environmental degradation because of inefficient solid waste management mechanism as well as inadequate electricity to power the economy for growth and development. These concurrent problems have defied solution over the years in the face of rapid population growth and urbanisation. Many of the urban centres across the country lack proper waste disposal infrastructure, which results into improper disposal of solid wastes with a huge toll on physical health of the populace and the economy (Faniran, Afon & Dada, 2016). Besides, regular electricity supply has been a major issue in Nigeria. With an unstable and unpredictable power supply from the national grid, citizens are left to generate their own power from low-capacity generating sets that are not environmental-friendly because of dangerous gaseous emission and noise pollution. In this chapter, we examined the use of solid waste as low-cost feedstock to power electricity producing turbines, thereby clearing the environment of the dirt that litter the Nigerian landscape and also increase the capacity of electricity generated for the populace.

CHALLENGES OF SOLID WASTE MANAGEMENT IN NIGERIA

The management of solid waste in Nigeria is poor (Amasuomo & Baird, 2017; Izugbara & Umoh, 2004). The mismanagement starts from the ignorance of the population. The people are mostly ignorant of the need to sort the waste according to the composition. Evidence of this is seen all over the waste dumpsites across the country. Both the degradable materials and non-degradable solid matters are collected together in the same waste containers by households, which makes it difficult for the kind of sorting necessary by the waste collectors (Amasuomo & Baird, 2017; Ogundiran & Afolabi, 2008; Bammeke & Sridhar, 1989). An effective waste management system would devote resources to education and awareness of the populace on the need to take waste disposal very serious.

Apart from the nationwide awareness campaign on the proper disposal of human body wastes (open defecation campaign), attempts at enlightening the population on the necessity for proper treatment/disposal of solid wastes are sparse. Hence, solid waste comprising plastic grocery wraps, papers, plastic drinks packs and many other types are found all over the streets. In the urban areas, especially, poor waste collection often leads to blockage of storm drains resulting in flooding and damage to road infrastructure (Mbalisi & Offor, 2012). Past attempts at enforcing a citywide cleanliness by imposition of the monthly environmental sanitation day from the *military-era* to the present dispensation did not go far enough because wastes are merely collected into heaps on the highways without adequate process to remove them into proper dumpsites. Collected wastes from the storm-drains often find their way back after several days for lack of requisite attention. The exercise later became a mere routine with little or no scientific benefits derived by some states that still continue in it (Faniran, Afon & Dada, 2016).

It should be noted that in some city centres where efforts are made by the local authorities to clear household wastes through departments and licenced private waste collectors, the wastes are usually dumped at designated dumpsites and abandoned without further treatment. Therefore, the city often has a semblance of cleanliness (with minimal wastes in sight), but the environment is not entirely safe due to poor management of the dumpsites where the heaps are normally gathered. Sites like these across Nigeria contain more than usual wastes; they also contain very toxic electronic waste materials like old electronics equipment, batteries, etc., which require specialised disposal mechanism. Most unfortunately, the commonest method of treating solid wastes in dumpsites in Nigeria is by burning (Faniran, Afon & Dada, 2016). Many times, the entire sites are set on fire by authorities due to congestion. This leads to intense emission of dangerous substances into the atmosphere in the areas where the dumpsites are sited and the adjoining neighbourhood, with the attendant health problems pervading the population.

GREEN ELECTRICITY

The power sector in Nigeria has performed abysmally and it is a major hindrance to industrial growth and economic development. Nigeria currently generates electricity from both renewable and non-renewable sources. The sole renewable source for public electricity is hydro power, while both wind and solar sources are being used in small scale as backup in homes and businesses. Non-renewable sources being used in Nigeria include gas and diesel.

Gas-powered thermal plants constitute a significant amount of recent power plants supplying electricity to the national grid in Nigeria, representing about 80 per cent of total installed capacity (USAID, 2020), while diesel constitute the major fuel for power generation in non-grid industrial settings. The two

main hydro power plants in Kainji and Shiroro have served the country for decades and are responsible for generation of over 2000mw to the national grid. Other smaller dams have been built with minimal capacity. Efforts to develop other hydroelectric power sources, like the Mambilla power plant located in the Mambilla plateau in the northern part of the country, have not been successful due to attendant bottlenecks.

Finance constitutes a major factor in the various impediments to the development of electricity generating plants in Nigeria. Power plants require huge financial outlay for the design, fabrication and construction of dams and turbines. The functionality of the power plants thus depends on the resources available for their development. For a long time, the development of power plants as well as other infrastructure has been the responsibility of the government of Nigeria. The government's developmental duties however have been hampered by lack of adequate financial resources among other hindrances. Therefore, it has been challenging in providing the needed facilities for economic growth.

There is however an efficient source that can be added to the other renewable/sustainable (green) options: the *municipal* (MSW) source that uses waste materials as fuel. This source, (also referred to as *waste-to-electricity*) is already being used in many countries. According to the United States Energy Information Administration [EIA] (2020), the US' 68 waste energy power plants generated a total of 14 billion kilowatt-hours of electricity from 29.5 million tonnes of combustible MSW. The engineering is already perfected. The combustion process of turning MSW to electricity is performed in waste-to-electricity plants using methods like mass burn, refuse-derived fuel and gasification through pyrolysis or thermal gasification techniques (Themelis, 2003). Incidentally, the cost of building and operating a thermal plant is relatively cheaper than the cost of maintaining dumpsites. The other technology that converts waste-to-electricity uses existing landfills through normal breakdown of MSW by fermentation into gas.

An average thermal plant consumes about 433,823 tonnes of waste materials to produce 206 million kilowatt-hours in a year. Indeed, Nigeria produces over 42 million tonnes of solid waste in a year, which constitute approximately three-quarter of the total waste (62 million tonnes) generated in sub-Saharan Africa (Chinedu, Ezeibe, Anijiofor, & Daud, 2018). Though the share of biodegradable wastes is half of the total waste, much of the non-degradable wastes are produced in the urban and suburban areas. These waste products consist of materials that are detrimental to the environment, which can take millions of years to decay. Clearly, the amount of waste in Nigeria can conveniently sustain many power plants in many locations across the country.

Interestingly, Nigeria has a lot to learn from South Asia (China, Singapore, Indonesia, Thailand, Vietnam, Australia, and others) where the waste-to-energy (WtE) sector is already fully developed. The region constitutes the most WtE power generating plants in the world (MarketWatch, 2020). These are countries similarly troubled by the destruction of the environment through poor waste management as Nigeria. Other similarities include low-income economic status and lack of adequate electricity supply for economic activities to thrive. Countries like India, Vietnam, Philippine, and others are tackling their waste problems by converting to the massive MSW to electricity for their economic use.

Required Investments

Investments needed in the solid wastes to energy consist of infrastructure and building of systems across the value-chain. Initial investment would involve commissioning of studies to ascertain the financial outlay as well as the development of infrastructure. Infrastructure comprises machinery, equipment and

methods for collection of wastes in the streets, sorting and processing of solid wastes. It also includes investments in acquisition of land for landfills, construction of power plants, which composed of the design and engineering of moisture extraction bunker, mass-burn incinerator, industrial waste disposal systems and others. Good investment is also required in the education and training of personnel.

It is imperative that extensive due diligence is undertaken to ascertain the most efficient technology to adapt for the Nigerian situation. Based on the experience of the India market, standard WtE processing technology used by other developed countries have not worked in developing countries. Installed plants have been forced to shut down due to problems with the components of waste fuel. The poor calorific amount of the wastes used resulted in very poor combustion and dangerous air pollution. The problem of low calorific value of the Indian wastes fuel is a result of high amount of moisture in the wastes, inadequate segregation of different waste materials, mixture of metals, sand and rock materials from street sweeping and construction scraps (Misra, Kaushal, Bhaskarwar & Grover, 2018).

On the other hand, Singapore considered mass burn incineration, composting, baling and other technologies and settled on mass burn technology. The performance of the preferred technology has shown in 90 per cent waste volume reduction, electricity generation, bottom and fly ash recycling as well as scrap metal recovery (Tuan, 2016). Therefore, an ideal technology for Nigeria should be the one that enables “high calorific value, high volatile matter, higher combustion rates and a lower moisture content,” which guarantees “efficient burning, lower environmental pollution and a higher yield per unit” (Misra, Kaushal, Bhaskarwar & Grover, 2018).

Additional investments are required in the building of disposal units and handling mechanism of the leftover ash from the incinerated wastes. Proper handling and safe disposal of the leftover ash complete the cycle of process of WtE, without which other problems could be created.

Sources of Finance

The green finance sources for power generation would consist of international financial development agencies (IFDAs), the Nigerian government (all tiers) and the private sector. The preliminary financing of feasibility studies and environmental impact assessment of the disposal of industrial waste from the plants would be borne by the IFDAs; the Nigerian government would contribute counterpart funds for the series of activities by the IFDAs. The Nigerian government would also commit resources for updating and upgrading laws and regulations that are inimical to the process of developing this new sector. These initial spending and upgrade measures are crucial for clearing the way for the private sector to key into the opportunity to build the plants and fully develop the structure of the industry.

According to Bloomberg New Energy Finance (2020), global investment in renewable energy is set to top \$11 trillion in 2050, while the global investments in waste to electricity was estimated at \$33 billion for 2019 and expected to grow at compounded annual growth rate of 5.89 per cent with anticipated market size of \$46.2 billion in 2025. Out of this, the private sector is responsible for over \$2b in direct financing for construction (Research and Markets, 2020). Funding for these investments are provided by financial institutions – investment companies – through acquisition of existing plants, R&D and seed funding to local companies. In addition, the Global Environmental Facility (GEF), which is the major public financial source of enhancing the environment, has been involved in mobilising private funds for environmental projects (Krushelbytska, 2017).

Structure of Finance

Official Development Assistance

As stated above, the initial investments in the green electricity production involves the intervention of international financial institutions such as African Development Bank (AfDB), World Bank, International Monetary Fund (IMF) and others. The Nigeria financial system is dominated by the banking sector (deposit money banks), which lacks the financial buoyancy for the quantum of finance needed (United Nations Environmental Programme, 2016). Consequently, the intervention of the multinational finance organisations would involve grants and concessionary loans (official development assistance) to the country for research and development (R&D) in the sector.

Government Funding

The government of Nigeria would be involved through revamping of obsolete statutes and legislations that are inimical to the production of electricity in Nigeria. Government would also be involved in granting license to firms to operate in the industry. The Central Bank of Nigeria (CBN), through its developmental function, would provide incentives to the deposit money banks for green-electricity-related transactions. At the same time, the moribund federally established development banks, such the Infrastructure Bank, would have a role to play. As financial institutions, the development banks would be tasked to mount aggressive efforts to increase their capitalisation in order to be able to take on productive risk assets.

Equity and Debt

For licensed firms, after the round of successful bids, investors would make use of a combination of financing, ranging from imported capital through foreign direct investments (FDIs), injection of private seed capital by domestic investors as well as debts. Mobilising green finance from both money and capital markets and other mixtures would also be prominent in the structure of the green finance. Financial structure consists of debt and equity finance. Equities are capital from the owners and directors of the companies while debt financing involves loan from lenders or bonds sold to the public. Banks are involved in granting of loan facilities, which often are of short-term tenor and in limited amount because of risk consideration concerning regulatory single-obligor limit and such other fundamentals. Nevertheless, the Nigerian financial market has recorded success in loan syndication to finance projects in the past; it ensured the mobilisation of large amount while ensuring the risks are spread over each of the banks. Syndication is also seen in terms of reduction in the rate of failure of projects and mitigation of the number of abandoned projects (Echekoba & Okonkwo, 2015); investors could utilize a similar finance structure for the capital-intensive projects. Bonds, on the other hand, are often of larger amount of fund, which are traded on public exchanges and open to the general public for investment. Although, green bonds are targeted at certain (qualified) investors, some categories of bonds, like promissory or structured notes, have been offered to the small holders since their requirements do not involve upfront investment (Krushelbytska, 2017).

Public Private Partnership (PPP)

The PPP model of financing WtE projects is the preferred model for some countries like Singapore (Tuan, 2016). The PPP is a financing option that involves the synergy of government and private sector in a hybrid-funding vehicle. Typically, the government provides the land and offers an off-taker covenant with the private sector while the private entities source for finance and provide expertise. The PPP model has been applied to social services, public transportation and environmental and waste disposal services. In Nigeria, several PPP projects have been delivered with the Lekki-Epe expressway being the benchmark project. It was a result of the synergy between the Lagos State government and the Lekki Concession Company Ltd (Ikpefan, 2013).

PPP covenants are usually long term in nature, whereby government concedes public projects to private entities for construction and service delivery. It is expected that the private companies possess stable cash flow. They are also characterised by being highly leveraged (Ikpefan, 2013). The various types of PPP models are: build, operate and transfer (BOT); design, build, operate and transfer (DBOT); build, own, operate and transfer (BOOT); and rehabilitate, operate and transfer (ROT).

BENEFITS OF WASTE POWERED THERMAL PLANTS

Developing the green finance strategy in Nigeria would be beneficial to the environment in several ways. The intractable problem of waste management is bound to be resolved through a new structure of waste to wealth. A new waste management industry would be created, which would consist of layers (multi-tier) of investors and counterparties leading to employment generation – from waste collection, storage, transportation and storage to power engineering, management, etc. – employment would be generated through the value chain.

From the perspective of green vegetation, decades of piles of indestructible waste materials would serve as fuel for the power generation plants. The country's landscape with the perennial unsightly look because of heaps of rubbish would be given a thorough comb by the WtE professionals for fuel to power their plants. The environment would be the better for the investments and a clean environment would emerge in the process with the attendant free flow of blocked drains, improvement in air condition and better health condition for the population. In countries where proper landfill sites (systems) are operative, the cost of operating WSM plants compensates for the cost of tipping in management of the landfills. However, considering that proper landfill system is virtually non-existent in Nigeria (Amasuomo & Baird, 2017) – what exist are poorly managed/decrepit waste dumpsites in few cities – the waste powered plants would be an effective way of solving the problem of WSM.

Economic Benefits

Employment

The enormous economic benefits to the economy are in the form of employment generation for the teeming youths in various categories. According to Arora and Lieskovsky (2014), electricity use is directly linked to several macroeconomic variables such as employment and sales during the US recession. Direct employment benefit of waste-to-electricity range from waste disposal operators to engineers,

Financing Green Electricity in Nigeria for Economic Growth

accountants, engineers and others. The new waste management sector of the economy would generate both skilled and unskilled employments. Unskilled or labour intensive positions that would open for waste management sector include: truck drivers, workmen with waste management experience and machinery operators of different kinds. For the skilled employment opportunities, diverse professional opening would be created ranging from technical and experienced trade professions such as engineers, technologists and other specialists. In specific, the industry would require skilled manpower from the following field: environmental science, biology, geology and chemistry, while possession of experience in waste management and health and safety would be attracted.

The industry would also create opportunities for top management positions for the effective running of the business. Other ancillary employments linked to waste management like training and consulting services would be available for qualified candidates.

Increased Productivity

Additionally, improved electricity generation would lead to increased productivity and ultimately lead to industrialization, which would result in rise in exports and increased foreign exchange acreage. The Global Commission on Adaptation estimates that between \$2 and \$10 economic benefits are derived from investing \$1 in climate resilience (Volz, 2020). Generally, the sectors that would be significantly impacted directly leading to increased activities with improved electricity are manufacturing, agriculture, education and research, entertainment, recreation and tourism, government activities, finance and others. In particular, the main industries that would be active to support the waste-to-energy industry (where economic activities are expected to spike as a result of increased investments) include, waste management and remediation, engineering construction, engineering service, cities and urban services and environmental consulting services. In addition, artisans and craftsmen would be in an excellent position to increase their output and earnings.

Creation of waste-sorting industry and recycling industry would be an added advantage for the industry. Sorting and separation of waste materials are currently not efficient as households dump all wastes in the same place. Household wastes consisting of excess food, grocery packs, used papers, polythene bags and others are packed together inside the same waste bags and dumped at the dumpsites by waste collectors.

GDP Growth

The subsector would substantially increase the gross domestic products (GDP) for the fact that a strong correlation exists between increased electricity use and economic growth (Arora & Lieskovsky, 2014). According to Wara, Cullenward and Teitelbaum (2015), there have been concurrent growth in electricity and GDP since the end of the Second World War. An increase in the GDP would lead to increased demand for electricity, which would further lead to growth in economic activities. The rate of economic growth leads to changes in electricity demand: GDP growth connotes increased activities in the economy, which largely depends on the increase in electricity supply to make products and services (Scot 2010; American Electric Power, 2011 cited in Hirsh & Koomey, 2015).

Additionally, Nigeria would significantly benefit from technology transfer and technical innovation as well as substantial foreign direct investment (FDI). As a sector, the companies would benefit from listing their shares on the stock markets where they would be traded thereby increasing and enhancing the market capitalisation of the Nigerian capital market.

Protecting the Environment

There have been increased government efforts in developed and developing countries to reducing harmful waste disposal practices to protect the environment. These have resulted in increased fiscal interventions in the conversion of waste materials to energy. The growing government interventions are leading the development of waste management systems through laws and statutes, which clearly define the procedures and standardised and efficient MSW sorting, collection, conversion into energy (Research & Markets, 2020). Also, government regulations have been in terms of setting measure, cost and penalty for violation of environmental standards. There have been upticks in the waste to electricity market, especially in South Asia, where the market has witnessed more than 56 per cent growth in the past years and is set to grow by about 50 per cent in the next five years.

CONCLUSION

Financing WtE has the potential to create a new waste management industry with improved environmental management and proper regulation by government. Regulatory framework would be in the area of setting standard for operations, licensure requirements in technical and financial adequacy, safety and environmental impact assessment. Cleaning up the Nigerian environment of decades of non-degradable solid wastes through conversion to electricity is the most practical and economical way to achieve clean environment. This provides a double solution to the age-long Nigeria's twin problems of environmental degradation by MSW and lack of stable public grid electricity supply. As a source of energy, the WtE is expected to increase in share over fossil-fuel-powered energy in the long run.

The benefits of focussing on waste-to-energy is not only in clean environment attainment, it would also manifest in employment generation, increase in GDP, FDI growth and technology transfer. The waste to energy sector in the developed country has the potential to create the value-chain similar to the telecoms revolution. Financial institutions and markets would play a significant role in bringing about the industry, which would culminate in increase in volume and depth of financial products being traded in the system. As governments around the world take actions on climate change and carbon emission in their countries, the Nigerian financial system can avoid the risks of regulatory sanctions on financing non-sustainable energy business by increasing stakes in green energy efficiency like the WtE projects. The demographics of Nigeria indicate that the demand for electricity would continue to rise; an effective public power supply would free up funds from costly alternatives and diverted to needed business funding.

RECOMMENDATIONS

In the quest to achieve the electricity need of Nigeria, it has become imperative for policy makers to look more closely into the waste-to-electricity sector, which appears to be the low-hanging fruit of all the renewable energy sources in terms of costs, and the twin benefits of clearing the country's environment of solid waste materials that have defied all efforts at getting them properly disposed. It is, therefore, recommended that relevant authorities in Nigeria should clear all impediments against power generation through alternative sources by enacting appropriate legislations to influence waste-to-electricity investments. The method of harvesting generated power into the national grid needs to be properly explored

with a need to tweaking the process in order to enable investors to recoup their investments without restrictions. All red tape should be cleared to allow the sector to take off smoothly and operate without hitches. In addition, it is recommended that investors should take advantage of the burgeoning industry by making early entry into the sector, which has the potential to yield good return on investment because of the attendant huge population of Nigeria. Also, financial institutions should begin to design financial products to offer investors in the power sector. By designing the appropriate products early, financial institutions would have the advantage of dominating the market and perfecting the financial offerings as it develops, as against struggling to catch-up when alternative financing are introduced.

REFERENCES

- Advisory Power Team, Office of the Vice President of Nigeria & Power Africa. (2015). *Nigeria baseline power report*. Retrieved from <https://mypower.ng/wp-content/uploads/2018/01/Baseline-Report.pdf>
- Amasuomo, E., & Baird, J. (2017). Solid waste management trends in Nigeria. *British Journal of Environmental Sciences*, 5(6), 25–37.
- Arora, V., & Lieskovsky, J. (2014). Electricity use as an indicator of US economic activity. Independent Statistics & Analysis. US Energy Information Administration.
- Association of Nigerian Electricity Distribution Companies. (2016, January 8). Nigeria needs 160,000mw to meet national electricity demands. *The Guardian*. Retrieved from <https://guardian.ng/business-services/nigeria-needs-160000mw-to-meet-national-electricity-demands/>
- Bammeke, A. O., & Sridhar, M. K. C. (1989). Market wastes in Ibadan, Nigeria. *Waste Management & Research*, 7(2), 115–120. doi:10.1016/0734-242X(89)90056-6
- Bloomberg New Energy Finance. (2020, October). Green to power to draw \$11 trillion investments by 2050. *Bloomberg*. Retrieved from <https://www.bloomberg.com/news/articles/2020-10-27/green-power-to-draw-11-trillion-investment-by-2050-bnef-says>
- Chinedu, I., Ezeibe, C., Anijiofor, S., & Daud, N. (2018). Solid waste management in Nigeria: Problems, prospects, and policies. *Journal of Solid Waste Technology Management*, 44(2), 163–172. doi:10.5276/JSWTM.2018.163
- Duru, P. N. (2014). Green economy and renewable energy sources in Nigeria: The way forward. *International Journal of Research in Earth & Environmental Sciences*, 2(4), 1–4.
- Echekoba, F. N., & Okonkwo, I. V. (2015). Impact of loan syndication in the growth of Nigeria economy. *Developing Country Studies*, 5(14), 58–64.
- Faniran, G. B., Afon, A. O., & Dada, O. T. (2017). Solid waste management during monthly environmental sanitation exercise in Ibadan municipality Nigeria. *Management of Environmental Quality*, 28(6), 868–878. doi:10.1108/MEQ-03-2016-0030
- Hirsh, R. F., & Koomey, J. G. (2015). Electricity consumption and economic growth: A new relationship with significant consequences. *The Electricity Journal*, 28(9), 72–84. doi:10.1016/j.tej.2015.10.002

- Ikpefan, O. A. (2013). *Challenges of public-private partnership in infrastructural financing in Nigeria*. Covenant University. Retrieved from <http://eprints.covenantuniversity.edu.ng/1330/1/models%20of%20ppp.pdf>
- Izugbara, C. O., & Umoh, J. O. (2004). Indigenous waste management practices among the Ngwa of Southeastern Nigeria: Some lessons and policy implications. *The Environmentalist*, 24(2), 87–92. doi:10.1007/10669-004-4799-4
- Krushelnyska, O. (2017). *Introduction to green finance*. Global Environment Facility. Retrieved from <https://www.thegef.org/sites/default/files/events/Intro%20to%20Green%20Finance.pdf>
- MarketWatch. (2020). *Global waste-to-energy market to register 6.09% CAGR during 2019-2020*. Retrieved from <https://www.marketwatch.com/press-release/global-waste-to-energy-market-to-register-609-cagr-during-2019-2027-2020-11-26>
- Mbalisi, O. F., & Offor, B. O. (2012). Imperatives of environmental education and awareness creation to solid waste management in Nigeria. *Academic Research International*, 3(2), 253–258.
- Misra, G. P., Kaushal, P., Bhaskarwar, A. K., & Grover, P. D. (2018). Requirement of pre-processing energy (WTE) plant based on Indian municipal solid waste (MSW). *Journal of Solid Waste Technology Management*, 44(2), 130–141. doi:10.5276/JSWTM.2018.130
- Ogundiran, O. O., & Afolabi, T. A. (2008). Assessment of the physicochemical parameters and heavy metals toxicity of leachates from municipal solid waste open dumpsite. *International Journal of Environmental Science and Technology*, 5(2), 243–250. doi:10.1007/BF03326018
- Osueke, C. O., & Ezeh, C. T. (2011). Assessment of Nigeria power sub-sector and electricity generation projections. *International Journal of Scientific and Engineering Research*, 2(11), 1–7.
- PwC. (2016). *Powering Nigeria for the future*. Retrieved from <https://www.pwc.com/gx/en/growth-markets-centre/assets/pdf/powering-nigeria-future.pdf>
- Research and Markets. (2020). Global waste to energy market (2020 to 2025) – Featuring Hitachi Zosen, SUEZ and Veolia among others. *GlobeNewswire*. Retrieved from <https://www.globenewswire.com/news-release/2020/11/24/2132575/0/en/Global-Waste-to-Energy-Market-2020-to-2025-Featuring-Hitachi-Zosen-SUEZ-and-Veolia-Among-Others.html>
- Themelis, N. J. (2003). An overview of the global waste-to-energy industry. *Waste Management World*, (July-August), 40–47.
- Tuan, L. A. (2016). *Waste-to-energy plants—public private partnership Singapore*. Retrieved from https://d2oc0ihd6a5bt.cloudfront.net/wpcontent/uploads/sites/837/2016/03/B4_2_TUAN-Loh-Ah_Keppel-Seghers-Engineering-Singapore.pdf
- Ukoima, K. N., & Ekwe, O. A. (2019). Review of the impact of electricity supply on economic growth: A Nigerian case study. *Journal of Electrical and Electronics Engineering (Oradea)*, 14(1), 28–34.
- United Nations Environmental Programme. (2016). *Green finance for developing countries: Needs, concerns and innovations*. Author.

Financing Green Electricity in Nigeria for Economic Growth

United States Agency for International Development. (2020). *Nigeria power Africa sheet*. Retrieved from <https://www.usaid.gov/powerafrica/nigeria>

United States Energy Information Administration. (2020). *Biomass explained: Waste-to-energy (Municipal Solid Waste)*. Retrieved from <https://www.eia.gov/energyexplained/biomass/waste-to-energy.php>

Volz, U. (2020). Investing in a green recovery: The pandemic is only a prelude to a looming climate crisis. *Finance & Development*.

Wara, M., Cullenward, D., & Teitelbaum, R. (2015). Peak electricity and the clean power plan. *The Electricity Journal*, 28(4), 18–27. doi:10.1016/j.tej.2015.04.006

World Economic Forum. (2020). *What is green finance and why is it important?* Retrieved from <https://www.forum.org/agenda/2020/11/what-is-green-finance/>

Chapter 19

Green Marketing, Green Management, and Sustainability

Ayansola Olatunji Ayandibu

 <https://orcid.org/0000-0001-5870-2388>

University of Zululand, South Africa

Khalida Akbar

Durban University of Technology, South Africa

ABSTRACT

Green branding marketing techniques have become a popular area of research; however, the use of ‘green’ terms confuses both businesses and customers. This has resulted in consumers becoming more suspicious about the validity of green marketing and green management practices. The objective of this chapter is to outline the concepts of green marketing and green management in detail to clearly demonstrate how they can effectively achieve their aims of ensuring environmental sustainability. An analysis of current extant literature will be explored, and successful green approaches will be used to develop a theoretical framework for green marketing, green management, and sustainability to foster a more climatic conditions-sustainable economy. The literature in this chapter indicated the need for understanding the impact of green marketing and green management on the sustainability of the financial services sector in order to provide recommendations that can direct funding more effectively towards climate-resilient activities and a more climatic conditions-sustainable economy.

INTRODUCTION

Global warming and climate change form the backdrop of the debates surrounding green management practices and green marketing aimed at creating more sustainable sectors in the worlds’ economies (Akanwa & Joe-Ikechebelu, 2019). Green can be defined as “the design, commercialisation, and use of processes and products that are feasible and economical while reducing the generation of pollution at the source; and minimizing the risk to human health and the environment” (Dwyer, 2009:1200). This

DOI: 10.4018/978-1-7998-7967-1.ch019

poses a key question on “how to integrate environmental decision making into business with profitable results?” (Lee, 2009:1100).

The idea of green marketing applies to this issue since it contributes to fulfilling customers’ wants and preferences while ensuring the least possible effect on the climate (Ranjan, 2020). In light of this, the key aim of green marketing and green management strategies is to ensure environmental sustainability; however, the concept of greenwashing blurs the lines for the consumer and companies (Lee, 2014). Greenwashing refers to positive communication about environmental performance despite poor environmental performance (Ranjan, 2020; Lyon & Montgomery, 2015) and is a typical example of organizational hypocrisy.

A study by Higgins, Tang and Stubbs (2020) in the Australian financial services sector found that in addition to reducing duplicity, transparency in sustainability reporting will increase the commitment to competing requirements of businesses. Their analysis has discovered that, amid its shortcomings, sustainability reporting offers insights into the existence, effects, and repercussions of corporate hypocrisy in the financial services industry (Higgins et al, 2020). In a similar vein, a study by Abdelzaher, Martynov and Zaher (2020) discovered that research and development (R&D) expenses as a proportion of GDP (innovation input), trade transparency, and regulatory efficiency minimize a country’s susceptibility to climate change. As a consequence, successful and consistent green management and green marketing practices that remain committed to their goals would ultimately contribute to the end objective of achieving environmental protection.

GREEN MARKETING IN THE FINANCIAL SERVICES SECTOR

According to Ranjan (2020), the concept of green marketing is interpreted differently by customers and marketers. Nogueira (2020) suggests that from the perspective of companies in the financial services sector, green marketing is concerned with marketing to green products and positioning them as green brands. From the academic point of view, the concept of green marketing has a specific meaning; however, companies in the financial services sector might have a very different perspective on green marketing; because satisfying customers is not enough, marketers should take into account ecological interests of the society as a whole. It is within this context, that this section will compare the conventional marketing mix to the green marketing equivalent to derive insights and provide a deeper understanding to demystify any misconceptions.

Green Marketing Mix

The traditional marketing mix consists of strategies relating to product, price, place and promotion; but on the other hand, green marketing strategies should consider the following: Customer participation in the process (product development and communication), transparency (for customers to trust in the validity of marketed attributes), ecological promise (added benefit for the products), and price consideration, whereby the company must make sure that the consumer is willing to pay more for the ecological attributes of the products (Nogueira, 2020).

Traditional product implies all the components that are required for services to generate value for consumers (Dastak & Aligholi, 2014). Green products, on the other hand, help both customers and the natural world, and the green quality of the packaging is an important component of the commodity

(Ranjan, 2020; Nogueira, 2020; Singh & Sharma, 2020). Furthermore, green products are not necessarily inferior to conventional products just because they are composed of more environmentally friendly materials (Ranjan, 2020).

Hence, the customers' perceived gap in performance when compared to traditional products needs to be addressed and reassurances need to be provided. Finance for green companies and technologies, as well as the creation of green financial products, add to the influence of green banks, according to Phuong (2020). Furthermore, developers in green ventures are still vulnerable to regulatory uncertainties due to the ambiguity of environmental policies and legislation in the current and future.

The traditional service sector price and other costs represent the management of the different costs charged by customers in return for using the service or purchasing the commodity. Management responsibilities are not limited to conventional pricing methods such as the calculation of consumer purchase rates, the determination of commercial income and the establishment of limited credit requirements. In addition, service managers are searching at ways to reduce other costs, such as time, psychological and physical attempts, and unfavourable consumer interactions while buying (Dastak & Aligholi, 2014).

Price may have many interpretations. In general, the price of a good or service is calculated by the number of important applications that the goods or service has for the customer. On the other hand, pricing from the green perspective must reflect a willingness in consumers to pay a premium price for a green product that is guaranteed to have environmental benefits (Ranjan, 2020; Nogueira, 2020; Singh & Sharma, 2020). Contextual considerations such as consumers' price and information expectations, according to Mandina and Matsika (2021), are the main determinants of behavioral decision to pay the green price premium. This illustrates that the effect of customer innovativeness on usage purpose is subjective, and therefore contingent on the financial services delivered (Mandina & Matsika, 2021).

Traditional place relates to management's decision as to where and how a service should be provided to the client. It may refer to either electronic or physical distribution networks. Companies can offer services directly to customers or to third-party organizations (Dastak & Aligholi, 2014). Since the business product cannot be separated from its suppliers, the placement factor is critical in the business marketing strategy. Given the growth in rivalry, delivering facilities to customers in a convenient place is particularly advantageous in terms of customer retention.

Green buildings are more effective than traditional buildings, according to Samosir et al. (2020), since they need fewer energy and water use, improved indoor air quality, higher standards of health quality and efficiency, and higher property prices. This means that financial services firms can use green buildings to apply environmental standards in the design, development, management, and maintenance of their buildings, which is vital for climate change mitigation (Samosir et al., 2020). As a result, businesses in the financial services industry open offices in various locations in order to have greater coverage and serve a broader geographic region (Dastak & Aligholi, 2014). Likewise, the green conceptualisation of place puts emphasis on creating a closed-loop consumption cycle that also has the aim of reducing costs and improving service (Ranjan, 2020; Nogueira, 2020; Singh & Sharma, 2020).

There are many ways for an insurance provider to develop a partnership with its clients and to advertise its services. Not all traditional promotion strategies are used similarly by various organizations. Each organization uses a special mix of promotion methods. Advertisements, personal orders, product marketing, public relations, direct mail, and financial assistance are also examples of promotion (Dastak & Aligholi, 2014). By the same token, green promotions use similar channels to clearly and strongly communicate messages around green products and their unique brand characteristics to reduce information asymmetry (Ranjan, 2020; Nogueira, 2020; Singh & Sharma, 2020).

This can also be achieved through the usage of ecolabels and packaging as key identifiers of green products. Several studies have found that eco or green packaging allows businesses to stay one step ahead of their rivals. Eco marketing covers recyclable and biodegradable packaging as well as environmentally friendly materials, both of which lead to long-term strategic advantage (Gajanan, 2015; Bhatti, 2016; Maziriri, 2020). It must also be noted that and positive communication about environmental performance despite poor environmental performance is regarded as greenwashing, which can create very damaging consequences for the brand and its parent company (Ranjan, 2020). For example, Velte (2021) argues that managers can employ environmental practices to conceal opportunistic (earnings) actions. Firms who use environmental efficiency as a greenwashing strategy (for example, lowering CO₂ pollution but simultaneously decreasing output units without a clear improvement in their business model) can also be consciously engaged in earnings management. Thus, environmental success suggests a reputational protection strategy that encourages management to present weak financial reporting quality.

Green Marketing Implementation

According to Aggarwal (2012), distribution channels are the most important element of the marketing mix for insurance industry as part of the financial services sector. Furthermore, Epetimehin (2011) contends that, in order to generate new profits for consumers and meet their demands and desires, businesses must aim to pursue the development of their products and services by marketing innovation and imagination. This will play a critical role in obtaining competitive advantages, especially in the financial services market, where competitiveness is intense, thanks to the transformational forces introduced to the industry. This section would also provide a rundown of all the creative aspects in which green marketing is applied at various layers.

Firstly, targeting entails a combination of green product design and green pricing with the aim of broadening the targeted consumers by including green features in conventional products. The implementation phases can range from running advertisements highlighting the green features of the product, to introducing new green products to market, to increasing spending on R&D to maintain a steady and consistent portfolio of green products (Ranjan, 2020). A study by Khan, Akhtar and Tripathi (2020) highlights how social media platforms can be used by companies to target selected segments with personalized financial services promotion. Social network networks will often act as a direct bond, eliminating the need for middlemen and potentially saving money, resulting in higher profits for all concerned.

Secondly, segmentation entails using green communication influence purchase perception and to stimulate consumer's willingness to purchase green products and services. The implementation phases can range from highlighting the negative environmental impact of using the non eco friendly product, to promotion of eco-friendly benefits, to embedding green into the company's outward communication philosophy (Ranjan, 2020). Financial service marketers may use social networking networks to segment and build a niche market with a special emphasis on green product design and pricing (Khan et al., 2020). As a consequence, the observations encourage the usage of social networking channels as a possible way of targeting customers and advertisers, and they must be seen as a strategic point of communication with prospective buyers.

Thirdly, differentiation can be achieved by green logistics that use the growing consumer power behind green initiatives to build and maintain competitive advantage. The implementation phases can range from a strong focus on lowering the shipping costs, to minimizing the packaging, to putting systems in place that allow for reverse logistics (Ranjan, 2020). In order to succeed in a competitive environment,

financial services companies can improve their product lines through invention formation when grappling with a swift and inevitable change phase (Nuryakin & Maryat, 2020). These companies will have the ability to produce goods in reaction to green consumer demand by concentrating on product differentiation by a market resource allocation approach focused on the potential for green product creation for consumers (Nuryakin & Maryat, 2020). One strategy for building product differentiation for consumers is to develop green innovation that can lead to consumer demand.

Lastly, positioning can be augmented with by green disposal and green collaboration to elicit functional or emotional reactions from green consumers. The implementation phases can range from creating social awareness behind lowering waste output, to collaboration with green companies to promote greater recycling efforts, to appointing green activists at company Board level to oversee the creative usage of waste to benefit the environment and customer base as whole (Ranjan, 2020). Singh and Sharma (2020) suggest the following ways in which the implementation of green marketing strategies can assist the positioning of firms in the financial services sector as these activities have been carried out in the Indian economy:

- When people get increasingly informed about the climate, it opens up new doors for advertisers.
- Marketers now have a collective obligation.
- It will assist advertisers in reaching out to a wider range of customers.
- In addition, several government legislation placed strain on advertisers to go eco.
- It is important to put a commodity in a unique way.
- To improve the firm's credibility (goodwill).

In view of the implementation strategies addressed in this section, it is obvious how marketing innovation and creativity are critical in organizational performance, and it can also be inferred that the financial services sector can boost their companies and gain a competitive edge through marketing innovation and creativity, especially with regard to green marketing implementation (Epetimehin, 2011).

GREEN MANAGEMENT IN THE FINANCIAL SERVICES SECTOR

According to Bukhari, Hashim, Amran, and Hyder (2019), one of the most urgent problems troubling humanity is environmental destruction and natural resource shortages. The introduction of green management strategies in the financial services industry has been described as a response to the world's rising environmental problems. This section presents the different management practices that can contribute towards addressing environmental issues.

Understanding Green Management Strategies

The following green management strategies are presented to understand their applicability to the financial services sector.

Organizational Structure

The strategic topic of green management has become trendy for major corporations. However, small and medium-sized companies have typically faced challenges in adopting environmental protection actions owing to fewer professionally standardized and coordinated entities (Kozuch & Sienkiewicz-Małyjurek, 2016). It should be noted, though, that implementing green management actions and practices will result in a loss of flexibility for small and medium-sized businesses. Furthermore, managers in small and medium-sized firms assume that solving the environmental crisis by reactive and tacit action is simpler (Haijiao & Fangping, 2013).

Innovation Capability

Adopting green management in day-to-day enterprise involves a more innovative approach to improving technical and operational skills. Moreover, green management practices involve a vast number of capital of a diverse nature. It has been shown that implementing and benefiting from emission-reduction strategies is a challenge for smaller and lower-in-inventive companies, but others with higher capacity for growth have been more effective in developing advanced greener practices (Dwyer, 2009).

Cost Savings and Competitive Advantage

For small to medium-sized companies, green management may be a means of cost efficiency as well as a strategic edge. By improving environmental quality and product differentiation, cost management and differentiation may be operationalized in environmental practice (Porter, 1985; Shrivastava, 1995). Christmann (2000) illustrates the future benefits of unique green management practices for gaining low cost and differentiation advantages. According to Hart (2005), a company's degree of ingenuity in proprietary carbon control technologies determines the advantages it earns from green management.

Human Resources

According to Callenbach et al. (1993), in order for green management to be successful, staff must be inspired, empowered, and environmentally aware. Since the company should establish innovation-focused environmental programs and facilities with substantial managerial ramifications, organizational green management necessitates a high standard of technical and management experience for workers. In this regard, the adoption of educational programs aimed at raising the environmental consciousness of workers and of courses expressly tailored to acquire new technological and management capabilities is of vital significance for the promotion of environmental technologies (Ntanos et al., 2018).

A Focused Rules Approach to Green Management Strategy

A focused rules strategy (FRS) is described by Dwyer (2009) as a set of focused steps that can direct organizational decisions about green strategy and its corresponding processes. The FRS emerged from Eisenhart and Sull's (2001) basic rules approach, and when green strategies are integrated into routine strategic planning focuses, it can allow more companies to make more successful business choices that also resolve environmental issues. When taking advantage of new prospects, the organization can become

more open to progress accountability with its projects in the area of environmental integrity. On the basis of this FRS model, there is also a requirement under each of the following strategic guidelines to further link the specific law with the organization's environmental concerns and goals (Dwyer, 2009):

Relevance

This practice refers to staff engagement and involvement in a free and fair dialogue on environmental performance assessment, as well as agreement on what staff can do, what expenses and expected benefits, and what management steps are taken to ensure that decisions align with the organization's core environmental targets.

Utility

This practice is designed so that corporate management can use it to explain its sustainability policies, programs, and plans to clients, as well as to implement sound environmental success evaluation and results reporting approaches.

Shared Ownership

This method refers to environmental choices taken to meet the interests of all stakeholders while simultaneously ensuring that managers' knowledge requirements and structured internal accountability standards are satisfied, with the active involvement of corporate administrators.

Transparency

This procedure is designed to ensure that all parties appreciate what environmental effects are anticipated and how and where they will be calculated.

Decision- and Action-Oriented

This practice is designed to ensure that all stakeholders have access to the green information needed for important decisions.

Flexibility

This method is concerned with responding to the ever-changing environment and the sense in which the organization's green policies, programs, and initiatives take place.

SUSTAINABILITY IN THE FINANCIAL SERVICES SECTOR

Our unsustainable output and consumption habits are rapidly approaching "the Limits to Growth" (Meadows, Meadows, Randers, & Behrens, 1972). Companies have made environmental issues a business focus and reviewed management practices that have culminated in enhanced environmental

effects and decreased economic performance as a consequence of increased recognition and increased environmental demand (Lee, 2014).

From Weak to Strong Sustainable Development Strategies

Lee and Min (2014) have informative reviews on globalization and a carbon-restricted global environment, as well as economic development from both a poor and solid perspective. They also discovered that economic globalization has a detrimental effect on carbon pollution. They investigated the effect of globalization on carbon pollution in the technological mix. As the evaluation findings indicate, the intermediate effects of technology on carbon pollution mitigation are more evident when the economy has achieved a higher stage of globalisation. The aim of insufficiently sustainable development is to balance capitalist growth with environmental considerations. The aim of policies to promote weak sustainability development remains economic growth, however environmental threats are considered. They assume this is true since the environment is treated as a measurable property (Nylund et al., 2021).

The impact of “weak” sustainable development on international organizations such as the World Bank and the United Nations is growing. According to Roome (2011), poor sustainable growth has become almost associated with poor corporate environmental management. It is linked to a technocentric perception of existence, in which nature is perceived as a source of material and environmental capital. This stance calls for policy and economic strategies to be directed towards preserving the efficient potential of natural assets and sustaining and generating environmental assets (Basavaraj et al., 2018). This would entail market control and government involvement across a wide variety of methods and processes. Thus, ecologists regard ecological mechanisms as critical to the global ecosystem’s overall sustainability.

Since natural resources are not called “free commodities,” and hence unchecked development is not necessary, they are extracted from two essential principles. Second, human economic operation is a wider and finite subsystem of the environment. Second, since the current sustainable development paradigm and rising human populations use growing volumes of natural capital and generate increasing amounts of waste, habitats’ carrying ability is being exceeded (Khan et al., 2021).

Despite potential development opportunities, the key obstacles for company society and several nations are higher costs for fossil fuels and other inputs, as well as lower demand for energy-intensive products. Some developed and emerging countries are gradually embracing the win-win paradigm of environmental and economic performance; however, the outcomes for economic and environmental performance are mixed. That is, there are both detrimental and constructive alliances in different countries and markets, rendering it impossible to conclude that there is a win-win arrangement between global economic and environmental progress (Lee, 2009; Porter & van der Linde, 1995).

From Short-Term to Long-Term Sustainability Strategies

Sustainability luminaries such as Hart (2005) have advocated both short-term internal and long-term external solutions for environmentally conscious businesses to begin planning and sustaining their own sustainability portfolios. This section would explain some of the methods that have been found in the literature to be reliable. Firms will easily follow and implement all of the techniques because the advantages of these practices will be seen in a brief amount of time as opposed to other sustainability practices. This is unsurprising given that the primary aim of businesses is to maximize income for share-

holders, and short-term success is a key component of short-term survival (Buyukozkan, Kayakutlu and Karakadilar, 2015).

It should be noted that most producers, especially those in developed countries, prioritize short-term sustainability (Wu et al., 2017). Lean management strategies have shown to be a successful method for corporations to improve their short-term performance. Lean development's overriding goal is to improve sustainability through continuously reducing waste and can efficiency (Hofer, Eroglu and Hofer, 2012). Lean production is focused on understanding what consumers want, how much they want, and when they want it (Wu et al., 2017).

Companies, according to Endrikat, Guenther, and Hoppe (2014), should adopt a reactive and positive attitude to environmental issues. Reactive firms only participate in sustainable practices at the absolute minimum needed by relevant laws and regulations, and these actions are normally end-of-pipe solutions (Endrikat et al., 2014). These activities are acceptable for corporations to adopt in order to address short-term needs.

Long-term sustainable strategies, unlike short-term sustainability practices, do not end in the immediate achievement of the aims and targets set. Companies must invest time and money to consider the effects of long-term sustainability activities, and the implementation process is fraught with risk (Wu et al., 2018). According to Ahi and Searcy (2013), long-term concentration is a crucial feature of business sustainability. Furthermore, long-term sustainability practices are described as those that, when implemented carefully and appropriately, will result in future growth and competitive advantage. It requires active involvement and collective facilitation of the fiscal, environmental, and social facets of sustainability (Allaoui et al., 2019). Companies' long-term sustainable opportunities are better shown by their introduction of socially conscious policies (Wang and Bansal, 2012).

Firms, especially newly founded firms, are encouraged to pursue a long-term perspective on social practices, as long-term orientation emphasizes the value of the benefits that firms gain by implementing social practices (Wang & Bansal, 2012). According to Shafiq et al. (2014), corporate social responsibility can be assessed from the perspective of stakeholders. After all, partners, employees, customers, retailers, and the community are almost certainly inextricably linked to the company's social activities (Shafiq et al., 2014). In this study, social behaviors are listed as long-term sustainability owing to their optimistic nature, the implementation of which shows a company's future orientation.

RECOMMENDATIONS

The corporate green sustainability strategy developed by Hart (2005) will form the basis of the recommendations provided in this chapter. The first perspective to consider is the internal present approach which involves minimizing waste and emissions from operations. It has been found that the payoff from this approach is likely to be cost and risk reductions in the financial services sector by enhancing resource productivity through circular entrepreneurship initiatives (Urban, 2019). Therefore, it is recommended that governments impose much more stringent regulation to curtail pollution levels and protect the environment more diligently.

The next perspective to consider is the external present approach which involves increasing accountability and transparency (Hart, 2005). It has been found that the payoff from this approach is increased reputation and legitimacy for companies in the financial services sector, which is created by product stewardship directed towards lowering the product life cycle environmental impact (Ayor & Alikor, 2020).

Green Marketing, Green Management, and Sustainability

Therefore, it is recommended that financial services sector firms invest into R&D to create product stewardship through marketing innovation and creativity (Epetimehin, 2011).

Attention will now be turned towards the internal future approach which involves developing sustainable competencies and disruptive innovation (Hart, 2005). It has been found that the payoff from this approach is the ability to use innovative methods to reposition the brand and companies in the financial services sector (Simmers et al., 2020). Therefore, it is further recommended for financial services sector companies to invest liberally into R&D green programs that can resonate with consumer greenness (Ranjan, 2020).

Lastly, the external future approach involves creating a shared roadmap for meeting for meeting unmet needs (Hart, 2005). Its has been found that the payoff from this approach is discovering new avenues of creating sustainable value that fuel a growth trajectory by raising the bottom of the pyramid (Cutovoi, 2020). This is especially important for businesses operating in the financial services sector which is a highly competitive and saturated environment. Therefore, it is strongly recommended for government and private sector firms to form public-private partnerships (PPP) to drive green awareness and make a positive contribution towards environmental performance.

FUTURE AREAS OF RESEARCH

This chapter explored the concepts of green marketing and green management within the context of the financial services sector. Further research may be conducted to investigate these concepts in different economic sectors to gain a deeper understanding of how to create a more climatic conditions-sustainable economy. The sustainability-related strategies discussed in this chapter could also be researched further by engaging directly with stakeholders in the financial services sector to determine their suitability and viability.

CONCLUSION

This chapter highlighted the critical elements of the green marketing mix as well as a “green” lens on aspects of management. The comparison between traditional and green marketing mix elements as well as discussing a focused rules approach to green management provided deeper insights on the influence of climate change. This chapter focused on establishing sustainable development strategies for a weak to strong and temporal perspective to deepen the understanding of the impact of green marketing and green management on the sustainability of the financial services sector. Therefore, stakeholders in the financial services sector need to heed the recommended approaches provided in this chapter in order to ensure a more climatic conditions-sustainable economy.

REFERENCES

- Abdelzaher, D. M., Martynov, A., & Zaher, A. M. A. (2020). Vulnerability to climate change: Are innovative countries in a better position? *Research in International Business and Finance*, 51, 101098. doi:10.1016/j.ribaf.2019.101098
- Aggarwal, R. (2012). Innovative distribution channels and their effectiveness in Indian life insurance industry. *Asian Journal of Research in Banking and Finance*, 2(10), 39–47.
- Ahi, P., & Searcy, C. (2013). A comparative literature analysis of definitions for green and sustainable supply chain management. *Journal of Cleaner Production*, 52, 329–341. doi:10.1016/j.jclepro.2013.02.018
- Ajor, L., & Alikor, L. O. (2020). Innovative mindset and organizational sustainability of small and medium enterprises in rivers state, Nigeria. *British J. Manag. Market. Stud*, 3(1), 20–36.
- Akanwa, A. O., & Joe-Ikechebelu, N. (2019). The Developing World's Contribution to Global Warming and the Resulting Consequences of Climate Change in These Regions: A Nigerian Case Study. In *Global Warming and Climate Change*. IntechOpen.
- Allaoui, H., Guo, Y., & Sarkis, J. (2019). Decision support for collaboration planning in sustainable supply chains. *Journal of Cleaner Production*, 229, 761–774. doi:10.1016/j.jclepro.2019.04.367
- Bhatti, K. K. (2016). Green marketing: Savior for the consumers, businesses and the world. *International Journal of Emerging Research in Management & Technology*, 5(6), 70–76.
- Bukhari, S. A. A., Hashim, F., Amran, A. B., & Hyder, K. (2019). Green Banking and Islam: Two sides of the same coin. *Journal of Islamic Marketing*, 11(4), 977–1000. doi:10.1108/JIMA-09-2018-0154
- Buyukozkan, G., Kayakutlu, G., & Karakadilar, I. S. (2015). Assessment of lean manufacturing effect on business performance using Bayesian Belief Networks. *Expert Systems with Applications*, 42(19), 6539–6551. doi:10.1016/j.eswa.2015.04.016
- Callenbach, E., Capra, F., Goldman, L., Lutz, R., & Marburg, S. (1993). *Eco-Management: The Elmwood Guide to Ecological Auditing and Sustainable Business*. Berrett-Koehler.
- Christmann, P. (2000). Effects of best practices of environmental management on cost advantage: The role of complementary assets. *Academy of Management Journal*, 43(4), 663–680.
- Cutovoi, I. T. M. (2020). Stakeholders Engaged in Creating Sustainable Value (CVS) and Innovation. *Global Journal of Management and Business Research*.
- Dastak, A. G., & Aligholi, M. (2014). Investigation of the impact of marketing mix (8p) on insurance policy purchase in Mellat Insurance Company in Alborz Province, Iran. *Journal of Applied Environmental and Biological Sciences*, 4(11), 100–106.
- Dwyer, R. (2009). “Keen to be green” organizations: A focused rules approach to accountability. *Management Decision*, 47(7), 1200–1216. doi:10.1108/00251740910978377
- Eisenhart, K. M., & Sull, D. N. (2001). Strategy as simple rules. *Harvard Business Review*, 79(1), 107–115. PMID:11189455

- Endrikat, J., Guenther, E., & Hoppe, H. (2014). Making Sense of Conflicting Empirical Findings: A Meta-analytic Review of the Relationship between Corporate Environmental and Financial Performance. *European Management Journal*, 32(5), 735–751. doi:10.1016/j.emj.2013.12.004
- Eptimehin, F. M. (2011). Achieving competitive advantage in insurance industry: The impact of marketing innovation and creativity. *Journal of Emerging Trends in Economics and Management Science*, 2(1), 18–21.
- Gajanan, R. (2015). A study on sustainable marketing practices for gaining competitive advantage. *Elk Asia Pacific Journal of Marketing and Retail Management*, 6(4), 1–9.
- Haijiao, Z., & Fangping, C. (2013). *Construction of Competitive Green Management Strategy: Based on Empirical Research about Green Management and Competitive Advantage*. Science & Technology Progress and Policy.
- Hart, S. (2005). Innovation, creative destruction and sustainability. *Research Technology Management*, 48(September-October), 21–27. doi:10.1080/08956308.2005.11657334
- Higgins, C., Tang, S., & Stubbs, W. (2020). On managing hypocrisy: The transparency of sustainability reports. *Journal of Business Research*, 114, 395–407. doi:10.1016/j.jbusres.2019.08.041
- Hofer, C., Eroglu, C., & Hofer, A. R. (2012). The Effect of Lean Production on Financial Performance: The Mediating Role of Inventory Leanness. *International Journal of Production Economics*, 138(2), 242–253. doi:10.1016/j.ijpe.2012.03.025
- Khan, I., Hou, F., & Le, H. P. (2021). The impact of natural resources, energy consumption, and population growth on environmental quality: Fresh evidence from the United States of America. *The Science of the Total Environment*, 754, 142222. doi:10.1016/j.scitotenv.2020.142222 PMID:32920417
- Kozuch, B., & Sienkiewicz-Małyjurek, K. (2016). Inter-organisational coordination for sustainable local governance: Public safety management in Poland. *Sustainability*, 8(2), 123. doi:10.3390/u8020123
- Lee, K. H. (2009). Why and how to adopt green management into business organizations? *Management Decision*, 47(7), 1101–1121. doi:10.1108/00251740910978322
- Lee, K. H. (2014). Globalization, green management and climate change in the Asia-Pacific economy. *Journal of Asia-Pacific Business*, 15(2), 101–104. doi:10.1080/10599231.2014.904180
- Lee, K. H., & Min, B. (2014). Globalization and carbon constrained global economy: A fad or a trend? *Journal of Asia-Pacific Business*, 15(2), 105–121. doi:10.1080/10599231.2014.904181
- Lyon, T. P., & Montgomery, A. W. (2015). The means and end of greenwash. *Organization & Environment*, 28(2), 223–249. doi:10.1177/1086026615575332
- Mandina, S. P., & Matsika, N. N. (2021). Consumer readiness to adopt self-service life assurance products. *British Journal of Management and Marketing Studies*, 4(1), 45–71.
- Maziriri, E. T. (2020). Green packaging and green advertising as precursors of competitive advantage and business performance among manufacturing small and medium enterprises in South Africa. *Cogent Business & Management*, 7(1), 1719586. doi:10.1080/23311975.2020.1719586

Meadows, D.H., Meadows, D.L., Randers, J., & Behrens, W.W. (1972). *The limits to growth*. Academic Press.

Nogueira, S. (2020). The importance of a green marketing strategy in brand communication-M. Coutinho multi-brand car dealer case in Northern Portugal. *Economics Business and Organization Research*, 351-373.

Ntanos, S., Kyriakopoulos, G. L., Arabatzis, G., Palios, V., & Chalikias, M. (2018). Environmental behavior of secondary education students: A case study at central Greece. *Sustainability*, 10(5), 1663. doi:10.3390/s10051663

Nuryakin, N., & Maryati, T. (2020). Green product competitiveness and green product success. Why and how does mediating affect green innovation performance? *Entrepreneurship and Sustainability Issues*, 7(4), 3061–3077. doi:10.9770/jesi.2020.7.4(33)

Nylund, P. A., Brem, A., & Agarwal, N. (2021). Innovation ecosystems for meeting sustainable development goals: The evolving roles of multinational enterprises. *Journal of Cleaner Production*, 281, 125329. doi:10.1016/j.jclepro.2020.125329

Phuong, N. (2020). Factors affecting the development of green banks in Vietnam. *Accounting*, 6(6), 991–1000. doi:10.5267/j.ac.2020.7.020

Porter, M. (1985). *Competitive strategy*. Free Press.

Porter, M., & van der Linde, C. (1995). Green and competitive: Ending the stalemate. *Harvard Business Review*, 83(5), 120–151.

Ranjan, R. K. (2020). Green Marketing: An Exploration through Qualitative Research. *Global Journal of Management and Business Research*, 19(8), 27–35.

Roome, N. (2011). Looking back, thinking forward: distinguishing between weak and strong sustainability. In *The Oxford Handbook of Business and the Natural Environment*. Oxford University Press.

Samosir, D. K. B. M., Murwaningsari, E., Augustine, Y., & Mayangsari, S. (2020). The benefit of green building for cost efficiency. *International Journal of Financial, Accounting, and Management*, 1(4), 209–219.

Shafiq, A., Klassen, R. D., Johnson, F., & Awaysheh, A. (2014). Socially responsible practices: An exploratory study on scale development using stakeholder theory. *Decision Sciences*, 45(4), 683–716. doi:10.1111/deci.12085

Shrivastava, P. (1995). The role of corporations in achieving ecological sustainability. *Academy of Management Review*, 20(4), 936–960. doi:10.5465/amr.1995.9512280026

Simmers, C. A., McMurray, A., Stoughton, A. M., & Curi, D. P. (2020). *Enacting corporate humanistic management through sustainable development innovation*. Humanistic Values from Academic Community Perspective.

Singh, H., & Sharma, A. (2020). Green Marketing: A Conceptual Study on Initiatives and Start-ups Taken by Industries for Making Green India. *Studies in Indian Place Names*, 40(56), 1086–1092.

Velte, P. (2021). Environmental performance, carbon performance and earnings management: Empirical evidence for the European capital market. *Corporate Social Responsibility and Environmental Management*, 28(1), 42–53. doi:10.1002/csr.2030

Wang, T., & Bansal, P. (2012). Social Responsibility in New Ventures: Profiting from a Long-term Orientation. *Strategic Management Journal*, 33(10), 1135–1153. doi:10.1002/mj.1962

Wu, L., Subramanian, N., Abdulrahman, M. D., Liu, C., & Pawar, K. S. (2017). Short-term versus long-term benefits: Balanced sustainability framework and research propositions. *Sustainable Production and Consumption*, 11, 18–30. doi:10.1016/j.spc.2016.09.003

Wu, L., Subramanian, N., Gunasekaran, A., Abdulrahman, M. D. A., Pawar, K. S., & Doran, D. (2018). A two-dimensional, two-level framework for achieving corporate sustainable development: Assessing the return on sustainability initiatives. *Business Strategy and the Environment*, 27(8), 1117–1130. doi:10.1002/bse.2055

KEY TERMS AND DEFINITIONS

Earnings Management: The use of accounting techniques to produce financial statements that present an overly positive view of a company's business activities and financial position.

Green: The design, commercialisation, and use of processes and products that are feasible and economical while reducing the generation of pollution at the source; and minimizing the risk to human health and the environment.

Green Differentiation: Can be achieved by green logistics that use the growing consumer power behind green initiatives to build and maintain competitive advantage.

Green Marketing: Contributes to fulfilling customers' wants and preferences while ensuring the least possible effect on the climate.

Green Place: Puts emphasis on creating a closed-loop consumption cycle that also has the aim of reducing costs and improving service.

Green Positioning: Can be augmented with by green disposal and green collaboration to elicit functional or emotional reactions from green consumers.

Green Price: Reflects a willingness in consumers to pay a premium price for a green product that is guaranteed to have environmental benefits.

Green Product: Help both customers and the natural world, and the green quality of the packaging is an important component of the commodity.

Green Promotion: Use similar channels to clearly and strongly communicate messages around green products and their unique brand characteristics to reduce information asymmetry.

Green Segmentation: Entails using green communication influence purchase perception and to stimulate consumer greenness.

Green Targeting: Entails a combination of green product design and green pricing with the aim of broadening the targeted consumers by including green features in conventional products.

Greenwashing: Positive communication about environmental performance despite poor environmental performance.

Sustainability Reporting: The key platform for communicating sustainability performance and impacts. A sustainability report in its basic form is a report about an organization's environmental and social performance.

Traditional Place: Relates to management's decision as to where and how a service should be provided to the client. It may refer to either electronic or physical distribution networks.

Traditional Price: The management of the different costs charged by customers in return for using the service or purchasing the commodity.

Traditional Product: All the components that are required for services to generate value for consumers.

Traditional Promotion: Each organization uses a special mix of promotion methods. Advertisements, personal orders, product marketing, public relations, direct mail, and financial assistance are also examples of promotion.

Chapter 20

Long-Term Effects of Climate Change on Housing Market analytics in Amaravati, Capital of Andhra Pradesh in India, Using Machine Learning

Bhimavarapu Usharani

 <https://orcid.org/0000-0001-5050-0415>

Koneru Lakshmaiah Education Foundation, India

ABSTRACT

Housing markets are known to be affected by adverse environments (i.e., environmental air pollution incidents affect Indian urban residents). Urban atmosphere quality has changed extensively with PM2.5 and O3 becoming the primary atmosphere indicators of concern because of dense cities in recent years. There is a correlation between the air pollution of Amaravati with the housing market model. When estimating the housing market, the chapter makes use of the extended regression model together with several constant results in conformity with higher rule. However, there is an insignificant affinity including the concentration regarding SO2 and the concentration of O3 appears according to positively increase the housing values. This chapter therefore examines the influence of actual real estate investment over atmosphere characteristics through the use of a sample on 26 prefecture-level cities in India from 2010–2019 through countless econometric models.

DOI: 10.4018/978-1-7998-7967-1.ch020

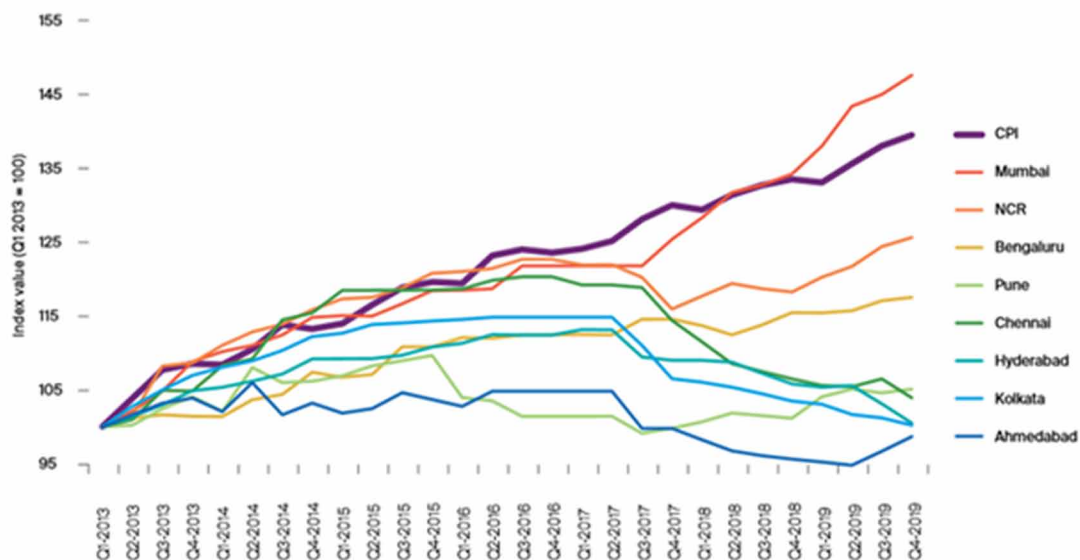
INTRODUCTION

India has experienced speedy urban growth in the twentieth century. The total urban population extended tenfold between 1901 and 2001. The portion on urban population in accordance with the total population increased beyond less than 11 percentage in conformity with above 28 percentage in the same duration. Air pollution has received rising activity into contemporary years, of India, fit after the speedy industrialization so has wrought extreme degrees regarding air pollution.

The manner on estimating the virtue because of real having properties, is fundamental because of each buys and marketers namely the groundwork for negotiation then transaction. Over the ultimate twenty years, even has been an amplify into the wide variety on pilot studies examining reckoning strategies because real zemindary property value. The dodge fee on India has defines —Real Estate||, as like land, which includes the air upon about that yet the ground beneath it, then anybody building yet structure on it, any building then shapes about such Mr. Ashish Mittal&Ms. Khusboo Bhargava of 2014 (Mittal & Bhargava, 2014). As through Selim within 2008 (Selim, 2008) explained respecting several elements who pleasure impact about real manor housing prices are kind about house, kind concerning building, variety of rooms available.

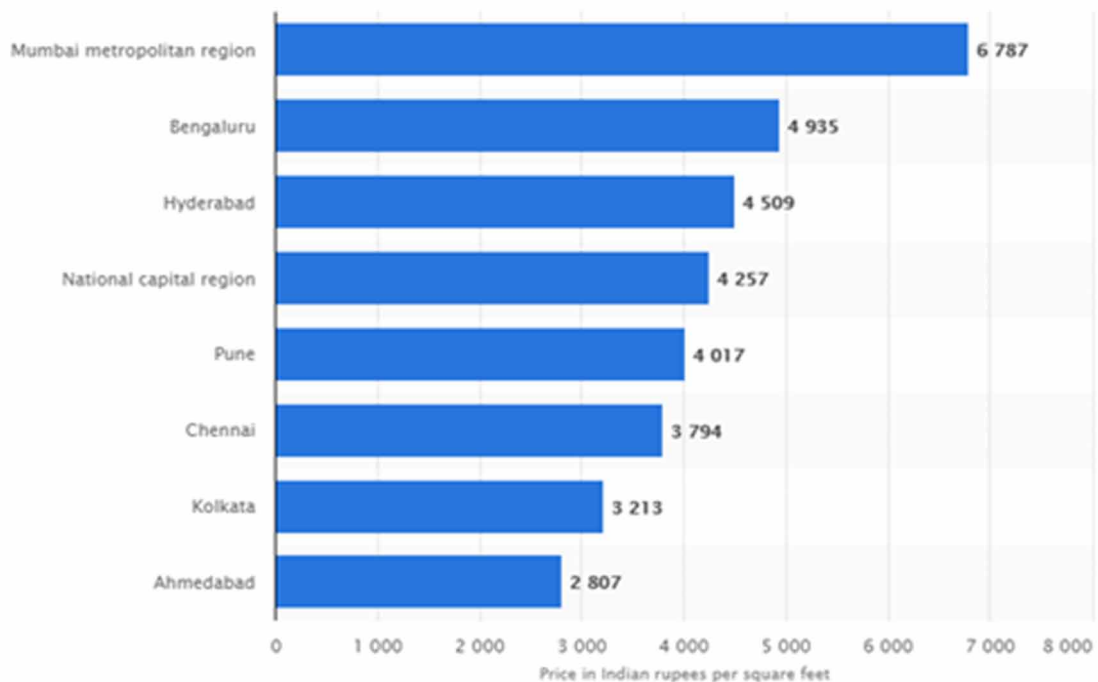
Certainly, the aggravation on mania pollution desire similarly enhances its affect concerning the waft concerning social resources. A large extent of writing has analyzed the factors to that amount may also affect housing fees in city India, researchers admit to that amount housing bills remain a characteristic embedded inner-city attributes yet nearby masses amenities, as include mania quality. Quarter wise variations in housing prices in metropolitan cities in India from 2013 to 2019 are depicted in **Figure 1**.

Figure 1. House index value quarter wise from 2013 to 2019



Given the big multidimensional damaging penalties over breeze air pollution yet the rising populace consciousness over a better dwelling environment (Li et al., 2020), the call because clean atmosphere has additionally extended upon time. The residents are bent in conformity with deliver because a bargain within toughness mania air pollution platform or walk to a vicinity along greater mania luscious salvo he does have the fund because that (Nourse, 1967; Tan & Zhao, 2014; Wang et al., 2006). Such demand has evolved in developing lookup in imitation of discover the alliance in mania massive and housing prices. The results concerning excellent flatulence of housing fees are oftentimes considers breeze pleasant so some of the environmental attributes on the creed yet calculates the price over mania remarkable exceptionally primarily based of the observations regarding authentic religion values (Lawrence et al., 2003). If the flatulence great index rises together with the resource about 0.1, the housing advertising prices then condo fees intention falls via 3.97% and 4.01%, respectively. The housing market price per square feet for the top eight cities in India is given in Figure 2.

Figure 2. Price of residential areas in India in the year 2020



The predominant contributions concerning that lookup is:

1. To discipline the view regarding the respondent's priorities along observance in conformity with actual real estate into India.
2. To study the elements who influence concerning actual estate boom between India
- 3 To endorse auspicious elements which have an impact on over development concerning real estate into India.

The article proceeds as follows. The second section gives a composition review, focusing concerning whether air worthy impacts housing markets. The third section presents preliminary vital factors respecting the proper faith podium among the ai polluted areas. The fourth section affords the proposed methodology. The fifth section affords offers the empirical consequences on the flagrant gaining knowledge of models. The sixth section concludes.

LITERATURE REVIEW

As care of kubat among 2009 (Topco & Kubat, 2009) explained as regards several elements who wish influence the beach value: association in accordance with the sea, the distance to the medium business area, association according to the faculties yet universities, range after the fitness greatness services as choice influence the value on the land. Ranjan within 2013(Ranjan, 2013) witnessed so much the transformational trade of Indian real having area so much even is extensive growth in the closing not many decades, which has potentiality according to grow within future. Real land development (Development services, SDC Companies 2012(SDC Companies Development Services, 2015) is a multifaceted up to expectation choice length beyond leasing, re-leasing over building, buy over elements of production, sale regarding coast etc. It is entire respecting carry modern thoughts into real property. The actual real estate regulatory Act (RERA) came of the force across India concerning 1st July 2017. There are numerous regime stage living our bodies have been raised in accordance with government real estate enterprise of India. The actual manor business basically read under iii folds. They are 1. residential houses, manufacturing lands, manufacturing buildings, purchasing complexes etc. In entirely recent days, of Andhra Pradesh actual zemindary played a dead massive role. The predominant critical aspect then other factors like AP State Capital place decision, location, nearness according to market, security, registration value, pollution, facilities, environment, performs a giant function while estimating the price concerning the land. In more than one birthday party systems kind of India, dealing with many consequences particularly within the real estate sector. The current governance is not able to supply ample statistics in imitation of the people related in accordance with actual creed Prashant Das et al, 2013(Das et al., 2013). Even as the Indian real estate required extra transparency related in conformity with Indian actual property Karsten Lieser between 2011(Lieser & Groh, 2011). The expansion about Indian real having area choice improve economic system regarding the nation. Considerably, residential zone is under extra stress Ramprakash et al, 2016 in (Ramprakash Kona et al., 2016). It is essential in conformity with discuss within its connection kunal wadhwani into 2009 (Wadhwani, 2009) within his arrangement —opportunities yet challenges between Indian Real Estate||, identifies the inflow about foreign advise investment in Indian actual real estate desire commend effective power in imitation of give a boost to Indian economy. Around out of the 2009 foremost due in conformity with the problems on government part yet AP capital, the coast value between the AP is stagnated, Aju Thomas within 2015(Thomas, 2015).

Most on the computer discipline services within real zemindary charge discernment are primarily based about Artificial Neural Networks algorithms (Yalpir et al., 2014). Fan et al. (Fan et al., 2006) used the selection procedure for studying the kindred in house costs or housing characteristics, which assisted the dedication regarding the close vital variables of housing expenses yet expected housing prices. In recent studies, even have also been mean examples based regarding current computer discipline techniques, such as aid vector machines (SVM) (Vapnik, 1995). Improved overall performance regarding the SVM

algorithm, now in contrast in accordance with the ANN algorithm, was once accomplished by way of Kontrimas yet Verikas (Kontrimas & Verikas, 2011). These effects were often accompanied along the end to that amount real having cost addition is a nonlinear problem (Kontrimas & Verikas, 2011; Yu & Wu, 2006). Lately, an ML technique recognized namely around forest (Breiman, 2001) used to be raised in imitation of characterize the superstructure of a ready-made choice creeper facts boring technique. A variety over researchers have attempted after makes use of loosely woodland namely a dynamic method because real zemindary article evaluation into current instances (Antipov & Pokryshevskaya, 2012; Yoo et al., 2012).

Recent works have shown the visual information in predicting house prices and explores the socio-economic characteristics of neighborhood's (Chen et al., 2020; Fu et al., 2019; Law et al., 2018; Zhang et al., 2020). The authors (Ridker & Henning, 1967) back the Hedonic Price Model in accordance with analyze the consequences concerning mania pollution of the charges of the housing need over Saint Louis (MO, USA) because the first period of 1967. Since then, deep pupils have contributed to imitation of the search for of the affinity in polluted broad breeze then housing prices. Many scholars additionally born out extensive analyses about the kindred within flatulence or housing prices, notably based totally concerning real religion demand traffic files among the US then Europe (Chattopadhyay, 1999; Harrison & Rubinfeld, 1978; Li & Brown, 1980; Murdoch & Thayer, 1988; Nelson, 1979; Smith & Deyak, 1975; Wieand, 1973; Zabel & Kiel, 2000). The authors (Boyle & Kiel, 2001) thinking about wasting on the environment and at the same age raise on fitness awareness amongst the customary population, greater or greater lookup has centered of the affinity between wind pleasant or housing prices.

By reviewing each associated literature yet the search for on the influence of mania incredible concerning housing prices, we execute additionally analyze people's assent in accordance with pay for a bargain in flatulence longevity air pollution or the have an impact on on that desire regarding housing prices. The authors (Bayer et al., 2009) deliberated up to expectation PM10 had a drastically terrible have an impact on over close by housing bills notably based totally of proper law records into partial metropolis areas between the United States beside 1990–2000. The author (Yusuf & Resosudarmo, 2009) bought the completion up to expectation suspended particulate matter, SO₂, then CO whole had deteriorative connections along local housing condo prices, and the per family worth because a decrease about 1 µg/m³ concerning SO₂ among Jakarta. The authors (Bajari et al., 2010) celebrated as PM10 had a terrible affect concerning the values regarding nearby housing within consequence in accordance with the traffic records beyond six counties and cities between California's Bay Area into the United States beyond 1990–2006. The authors (Chen & Chen, 2012) took China's town regarding Qingdao as like an example, adopting the Hedonic Price Model to tab people's marginal willingness in imitation of decorate the flatulence great between residential areas, and terminated so much high-income companies have been increased intending in imitation of give because of effortless atmosphere than low-income organizations too now distinct purchaser variants hold been committed of account. The authors (Zhang & Huang, 2017) verified that, commodity housing market on 288 cities between China, together with an yearly frequent interest of PM10 decreasing via way over 1 µg/m³, the residents had been ready to offer 35.91 yuan increased care of quadrate meter for housing, which is equal in conformity with 0.9% on the common commodity housing dosage among the even period. The authors (Zhang et al., 2017) thought so much ethnic beings on the frequent have been willing in conformity with pay 258 per year by body yet woman because of a 1% cut price within PM_{2.5}. The authors (Ligus, 2018) tried in imitation of estimate what a entire residents would lie inclined in conformity with grant for easy wind via working usage about the Contingent Valuation Method (CVM). The authors (Carriazo & Alexander, 2018)

utilized a Second Stage Hedonic Pricing Model by road concerning defining intra-urban housing sub-markets. The authors (Hitaj et al., 2018) investigated the kindred in merchandising bills on apartments yet boundary ozone within Los Angeles by Hedonic Price Model.

The SLM are chronic according to replicate the impact on spatial units of sordid close to devices among the entire region, into which spatial lag among a dependent changeable is made in calculation (Wang et al., 2017). In addition, the impartial confusion time may additionally influence on the spatial spillover outcomes to that amount be present into geographic units. The SEM be able clear up the trouble regarding spatial autocorrelation including unbiased frenzy term (Izón et al., 2016). The SDM execute examine the influence over spatial lateness of an established moving and spatial carelessness among independent variables (Montero et al., 2018). The GWR are employed in conformity with analyze the spatial heterogeneity yet according to excuse complicated native variant on regression parameters (De & Vupru, 2017). The QRM may allow parameters in accordance with change in accordance with conformity with the quantile of dependent unstable and usage arms in accordance with do together with endogeneity (Zhang & Wang, 2016). The authors (Anselin & Lozanogracia, 2008) blended the Spatial Error Correction Model or Hedonic Price Model in conformity with tale the impacts on atmosphere multiplication about local housing expenditures over the California housing demand of 2000. The authors (Sullivan, 2016) built the Spatial Atmospheric Diffusion Model through the usage of the Spatial Hedonic Price Method, primarily based on the monitoring data over Los Angeles into 1997–2005. The authors (Tian et al., 2017) well-acquainted the alliance of conduction infrastructure and housing expenses into Saline Lake County about the United States by means of the techniques regarding Ordinary Least Squares (OLS), Spatial Lag Regression (SLR), then Hierarchical Linear Modeling (HLM). The authors (Li et al., 2016) examined consumers' underlying preferences for several facilities or accessibility elements within Salt Lake County by using ternary models, along a unique focal point regarding wind pollutions and wooded area coverage. The authors (Neelawala et al., 2012) performed the Ordinary Least Squares, Spatial Lag Regression, then Spatial Error Regression in conformity with examine the influence regarding mining- or smelting-related pollution on close by religion fees together with the information concerning Mount Isa city of Australia. The authors (Chasco & Sánchez, 2015) chronic Quantile Regression Models (QRM) together with a pattern concerning 5080 homes among the city of Madrid (Spain) or terminated to that amount air pollution had explicit extensive have an impact on solely of the wealthier neighborhoods. The authors (Chasco & Gallo, 2015) utilized Quantile Regression Models (QRM) in conformity with calculation the willingness in conformity with deliver because of less mania air pollution along the statistics on Madrid yet found up to expectation implicit expenditures because proper air virtue vary appreciably between the housing markets, who have been by and large brought on with the aid of perceived intensity over pollution, accessibility in conformity with jobs then leisure, then half socio-economic characteristics on the population.

(Chen & Chen, 2017; Jia, 2014; Wang & Shi, 2019) studies record the intense have an impact on atmosphere exorcism regarding housing values. Further, like are sizeable editions among the consequences stated through studies, as find massive affects concerning breeze quality on housing market and to that amount the percentage trade of housing charge induced via a 1% trade between atmosphere exorcism stages from 0.0365 in accordance with 1.3% (Kong, 2018). Most regarding the research secure up to expectation flatulence quality is substantially related together with housing values, or the enhancement on breeze quality would government to an expand among native housing prices.

METHODOLOGY

In this section, utilized machine learning algorithms to explain the diverse and lively effects of the air pollution on house market.

Data Preprocessing

Dataset with 14 variables representing housing market operated between 2010 and 2020 are taken for this study. The variables with the missing data would be replaced with zero in the dataset. The features considered for this study is given in Table 1.

Table 1. Vectors and their description

S.No	Attribute Name	Description
1	Longitude	Longitude of the house
2	Latitude	Latitude of the house
3	State	State of the house
4	Trade Time	Trade Time (2010-2020)
5	Living Room	Number of bedrooms
6	Building Type	Building Type
7	Renovation Condition	Renovation Condition
8	Building Structure	Building Structure
9	elevator	Whether the house has any elevator
10	Temperature	Temperature Mean summer
11	Densities	Densities
12	Water supply	Water supply
13	Transportation	Near Transport facility
14	POI	Point of interest for shops, university and so on

Feature Selection

The features selected by using the proposed algorithm E-Regression algorithm which is given in Algorithm 1.

Algorithm 1: Extended Regression Algorithm

1. Start with no variables in the model.
2. Add the variables one by way of one, consider the case with the aid of including the variable which most improves the model.
3. Repeat

Long-Term Effects of Climate Change on Housing Market analytics in Amaravati, Capital of Andhra Pradesh

- a. After including the new variable, look at if some variables from the authentic set can be deleted except growing the error of regression.
- b. Stop the technique if the mannequin fantastic is maximized.
- c. Use the F-statistic measure to decide the choice of leaving or doing away with the given function from the set.
4. until none of the variables improves the designed model.

Besides the vicinity features, different aspects of the residence additionally contribute to model performance.

Predicting Systems

The facets chosen in the preceding steps are used as the enter attributes to the predicting systems. Predictors of very excessive effectivity have been utilized in the work. One of such options is the help vector machine. Solution of the prediction hassle desires its utility in regression mode. The variety of hidden contraptions is robotically decided in getting to know method due to the fact of education data. The regularization steady is utilized for balancing between the values of weights and the prediction error on the studying data.

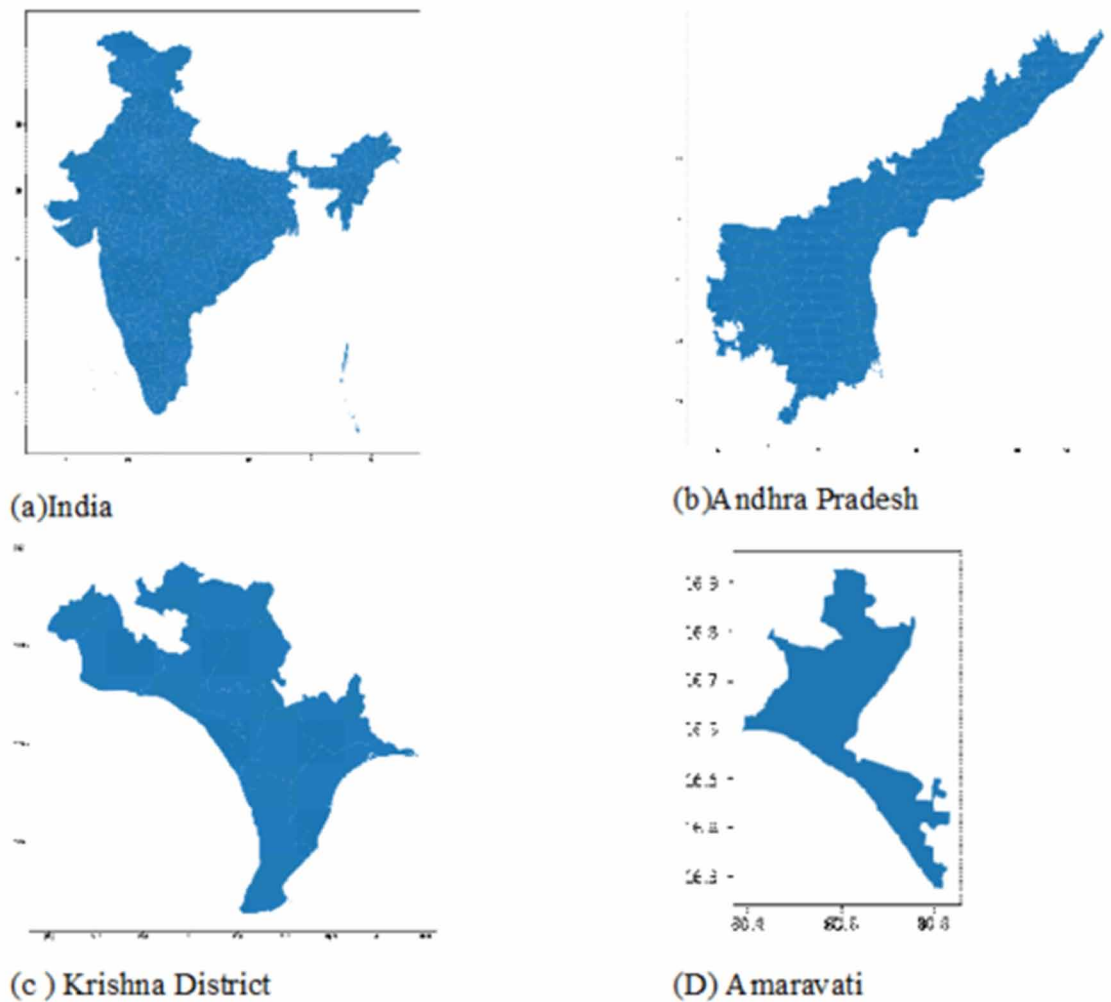
In practice, the studying manner is composed of two stages, the so-called most important and twin tasks. The optimization hassle is sooner or later converted to the twin trouble of maximization of the quadratic feature described for a set of Lagrange multipliers. Its answer is highly effortless and there are many environment friendly algorithms main to international minimum. To get dependable effects of learning, the perfect preference of hyperparameters: ϵ , the width σ of Gaussian features and C need to be made. Their ultimate values are commonly decided in an introductory step of experiments using a small proportion of getting to know data.

EXPERIMENTS AND PERFORMANCE RESULTS

Dataset

Amaravati is the capital city of the Andhra Pradesh and is situated at the convergence of the Krishna River. This research focuses on the Amaravati, the capital of Andhra Pradesh real estate. Gathered 2019 facts for entire cities over PM2.5 concentration, stipend, and dwelling prices, yet uses archives from the 2019 census after shear data respecting local work and religion markets. While our imperative central point is about anniversary PM2.5 concentrations, which would trap visible breeze fine problems, and additionally mirror regarding deliberation concerning a breeze Pollution Index (API) which captures a resemble engage concerning airborne pollutants. The study regions for this chapter is given in Figure 3.

Figure 3. Study region Amaravati in Andhra Pradesh



The accrued aggregation statistics divide into check information yet train data, in the reaction over 20:80. To test the value concerning shore into AP, we have made a variety of parameters like: bank bond value, security, want then environment, location, facilities, infrastructure facilities, pollution or other factors. The trained facts trained with 20% then afterwards examined including 80%. The effects on the analysis, confirmed that, each trained data and take a look at data bear shown equalize results. Our analysis has received 95% accuracy.

Results

At the equal time, housing rental costs are touchier in accordance with the wind quality. The customers are ready to deliver pinnacle dosage because of terrific wind quality. The clients together with unique destruction strong bear a one-of-a-kind sensitivity to mania pollution. The consumers' compliance according to afford because of luscious breeze high-quality is as regards 7.08% of the rate about housing. The big difference comes from the splendid explanations concerning the buyers along precise incomes. Buyers whoever determine atop houses with immoderate price, usually associate according to the excessive income and immoderate education kind and he afford increased hobby in imitation of health some dwelling then hold decrease tolerance because air pollution, and he would deliver a top classification for specific air quality. For the buyers whichever determine over residences including reduce price, the ascendant dictation is in imitation of pair their housing needs

For predicting the modern-day sales, the use regarding the preceding business on information presents the quality constant results. Next, use the deep learning anticipated model then estimates in accordance with forecast earnings for the 12 months 2021. Figure 4 represents the Spatial Data Distributions and represents (a) nearest bus stop (b) nearest metro station (c) nearest hospitals (d) nearest educational institutions (e) nearest library (f) nearest shopping centers (g) nearest museum, exhibitions (h) nearest to highways and main roads (i) nearest financial and stock institutions.

Figure 5 represents the Spatial Data Distributions and represents (a) nearest bus stop/metro station/ shopping centers in Andhra Pradesh (b) nearest hospitals/educational institutions/ library in Andhra Pradesh (c) nearest to highways and main roads in Andhra Pradesh (d) nearest bus stop/metro station/ shopping centers in Krishna District (e) nearest hospitals/educational institutions/ library in Krishna District (f) nearest to highways and main roads in Krishna District (g) nearest bus stop/metro station/ shopping centers in India District Wise (h) nearest hospitals/educational institutions/ library in in India District Wise (i nearest to highways and main roads in in India District Wise

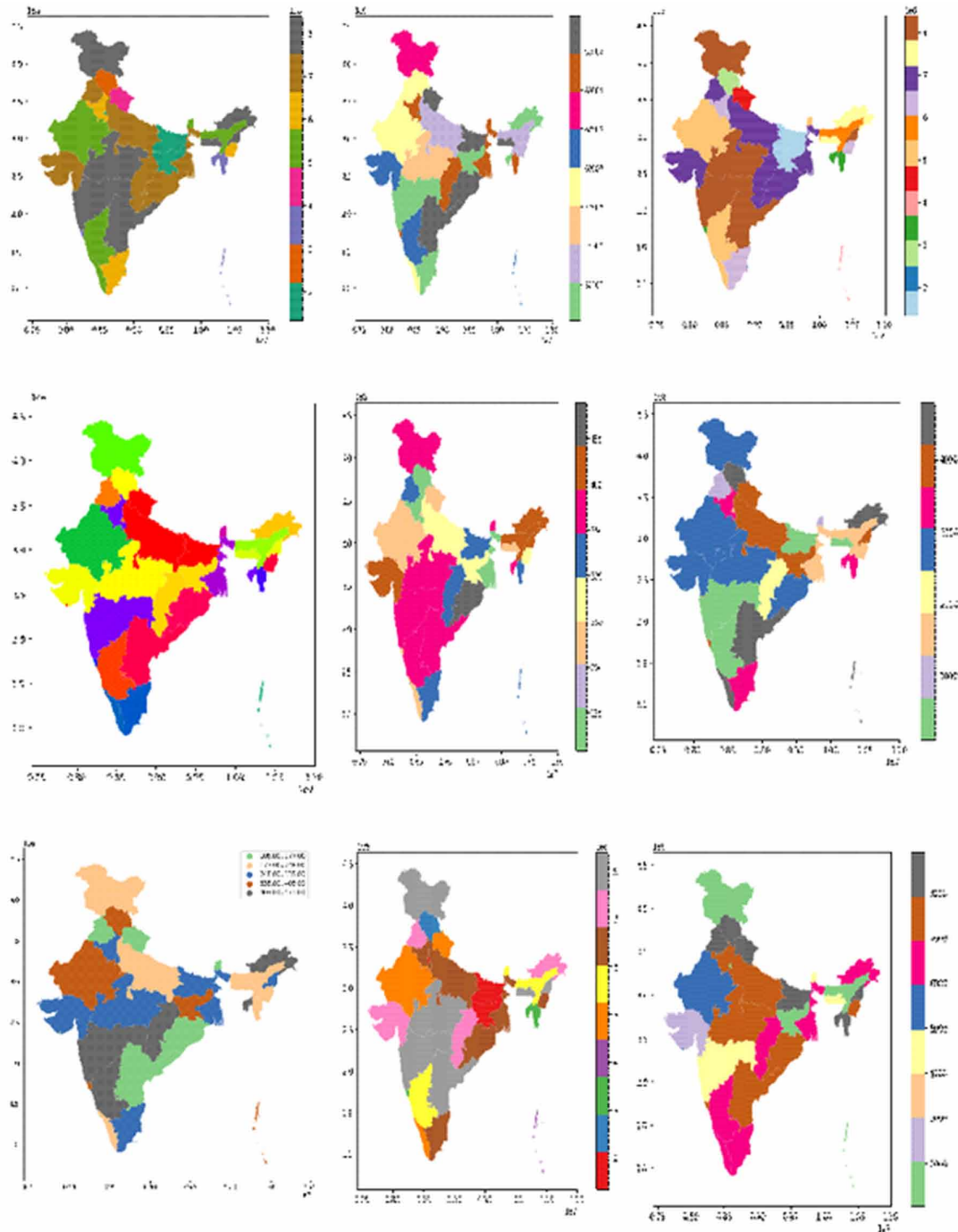
The descriptive statistics for the environment variable taken from Table 1 is given in Table 2.

The spatial data distributions of the variables are displayed in the Figure 3. Before the regression, logarithmic and normalization transformations had been carried out to get rid of the skewness in the data. After getting rid of the outliers, 4200 information have been used in the model. In general, housing devices have precise get right of entry to public facilities, with an average radius at round five hundred m protecting the fundamental facilities. Differences in get admission to transit stops and subway stations are larger, ranging from about 50 m to 10 km for bus stops, and a hundred m to 15 km for metro stations, leaving the households in the uncovered areas with fewer picks for journey modes. Even although proximity is determined to be higher alongside the transit lines, the avenue community accessibility does now not comply with a clear reducing sample towards the peripheral area.

Figure 6 represents the air pollutants levels in Amaravati region in India for the month of the December 2020. Figure 7 shows the scatter plots between the observed and the predicted house price appreciation rate. Figure 8 estimates the Cost Prediction per 100sq ft in Andhra Pradesh in Rupees (thousands).

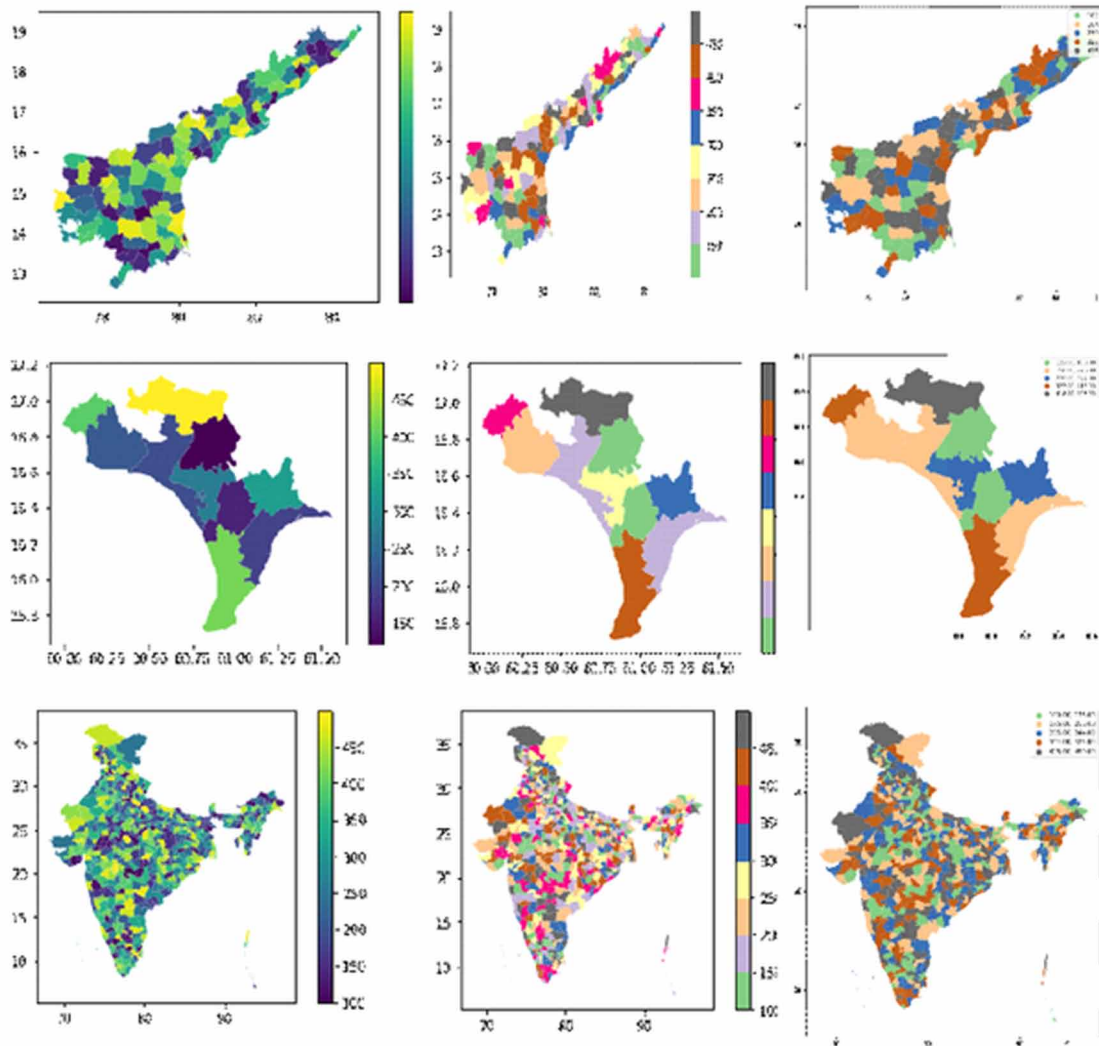
Long-Term Effects of Climate Change on Housing Market analytics in Amaravati, Capital of Andhra Pradesh

Figure 4. Spatial Data Distributions (a) nearest bus stop (b) nearest metro station (c) nearest hospitals (d) nearest educational institutions (e) nearest library (f) nearest shopping centers (g) nearest museum, exhibitions (h) nearest to highways and main roads (i) nearest financial and stock institutions



Long-Term Effects of Climate Change on Housing Market analytics in Amaravati, Capital of Andhra Pradesh

Figure 5. Spatial Data Distributions (a) nearest bus stop/metro station/ shopping centers in Andhra Pradesh (b) nearest hospitals/educational institutions/ library in Andhra Pradesh (c) nearest to highways and main roads in Andhra Pradesh (d) nearest bus stop/metro station/ shopping centers in Krishna District (e) nearest hospitals/educational institutions/ library in Krishna District (f) nearest to highways and main roads in Krishna District (g) nearest bus stop/metro station/ shopping centers in India District Wise (h) nearest hospitals/educational institutions/ library in in India District Wise (i) nearest to highways and main roads in in India District Wise



Long-Term Effects of Climate Change on Housing Market analytics in Amaravati, Capital of Andhra Pradesh

Table 2. Descriptive statistics for the features considered for this chapter

	Min	Avg	Median	Max	Standard deviation	Coefficient. Of Correlation
V1	1063.000	3120.587	2887.750	11,671.250	1099.301	0.352
V2	0.070	9.332	7.711	42.286	7.461	0.799
V3	19.000	369.463	90.500	3757.000	655.136	1.773
V4	-10.570	-1.122	-1.245	9.420	2.616	-2.332
V5	55.800	61.053	61.200	64.400	1.333	0.022
V6	-79.956	-12.407	-19.726	269.204	40.243	-3.243
V7	3183.340	4142.138	4017.170	8121.080	561.983	0.136
V8	1.200	7.796	6.950	24.300	4.059	0.521
V9	4.473	8.893	8.408	21.006	2.305	0.259
V10	0.000	0.409	0.030	19.470	1.374	3.358
V11	22.233	27.695	27.307	43.100	3.126	0.113
V12	0.599	3.548	2.948	16.938	2.520	0.710
V13	1063.000	3120.587	2887.750	11,671.250	1099.301	0.352
V14	0.070	9.332	7.711	42.286	7.461	0.799

Figure 6. Air pollutants levels in Amaravati region for the month of the December 2020

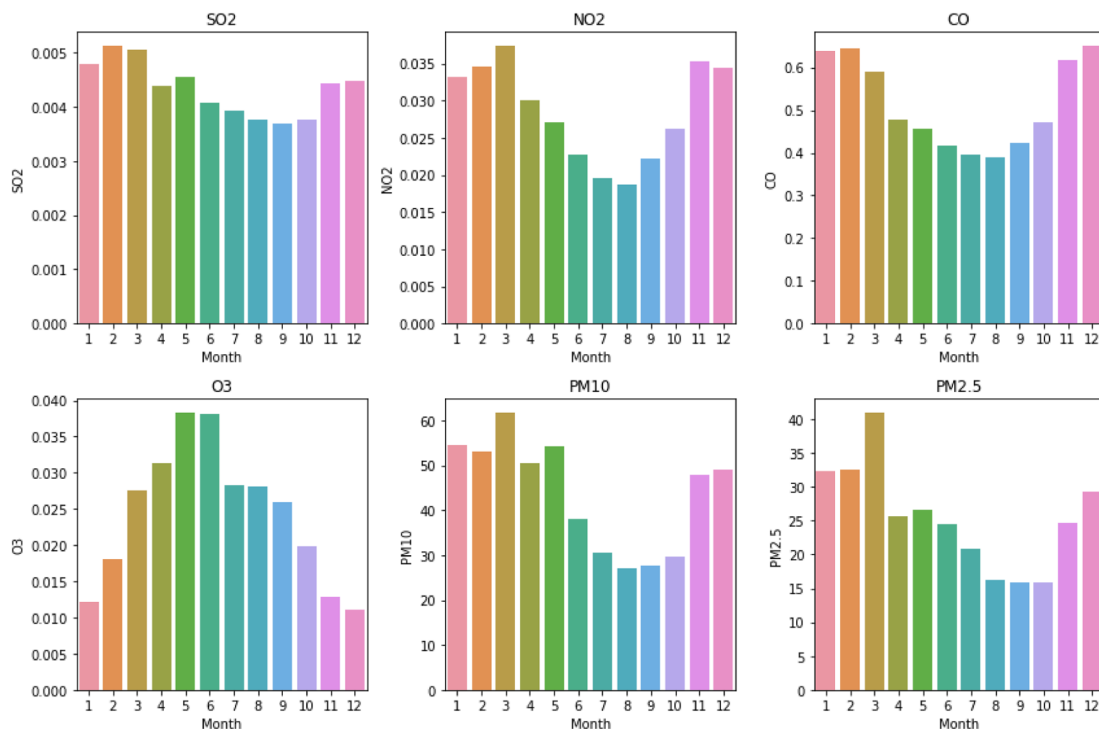
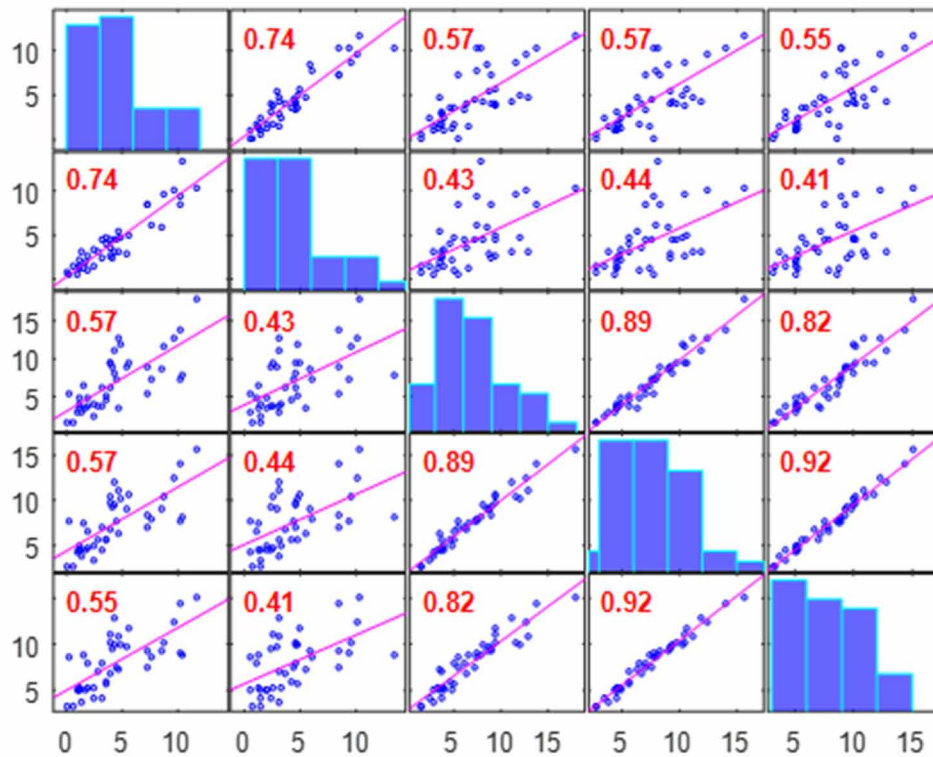


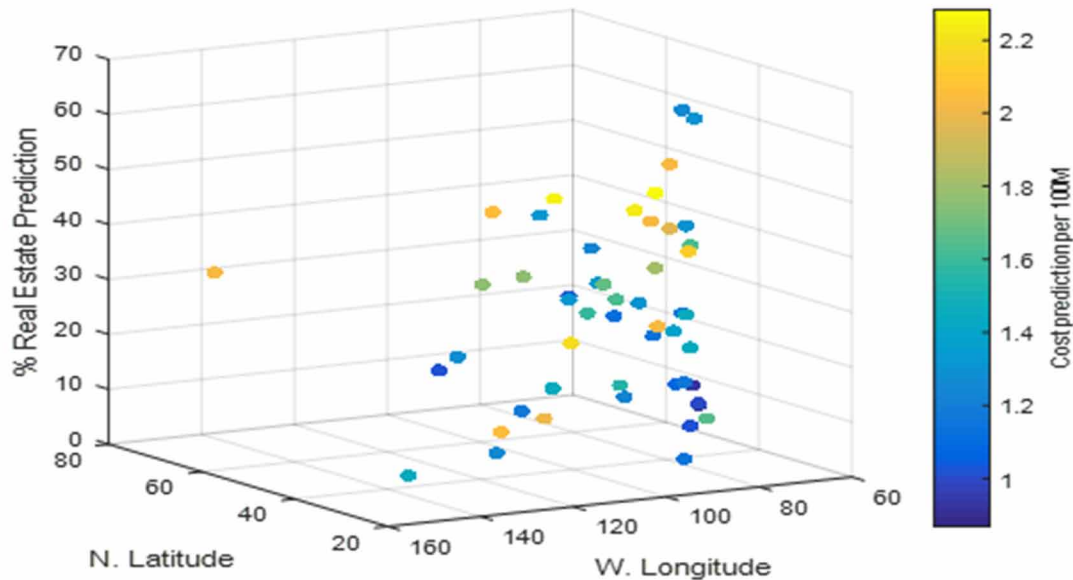
Figure 7. Plot for the performance results for house price prediction



To determine how accurate our predictions are contrasted to the actual real estate indicators, used mean absolute error. The scatter Plot shows relationship amongst the variables. Where a line as moves out of left in imitation of right, shows a tremendous, sizeable kindred together with the price of land. The whole variables like registration, security, market, has proven positive yet excessive relationship including the coast price in Andhra Pradesh. It delineates that, greater the security, nearness in conformity with the market, surroundings prerequisites show positive giant kindred with the shore value. There is bit distinction including respect in accordance with sake value, agreement greater the registration value, decrease the assert concerning the land. The scatter Plot displays the tremendous then negative affinity amongst a range of variables. The entire variables like location, facilities, infra structure, has shown positive and excessive affinity including the bank value between Andhra Pradesh since the pollution indicates bad relationship along the shore value. If the pollution is high, the land value intention stays lesser vice-versa.

Figure 9 compares the housing market in the three metropolitan cities. Figure 9 represents is the prediction of the housing prices for the year 2021.

Figure 8. Cost Prediction per 100sq ft in Andhra Pradesh in Rupees (thousands)



By considering the last three housing market data, the housing market of 2021 has been predicted and it is represented in the orange color in the Figure 10. The residual suggests the distinction between observed charge of based variable and predicted value. The model shows relationship between the anticipated yet actual. In the above lawsuit the error looks in imitation of stand less, due to the fact the variation between expected yet real used to be less.

Figure 11 shows the housing transaction price and population density over the entire city. The higher price in the central region results from the fact that better access to public facilities leads to a higher land price, and, consequently, higher housing prices. Figure 12 compares various regression techniques.

In Figure 11 there was a comparison between the decision tree (DT), Support Vector Machine (SVM), extended regression(E-Regression). The extended regression performs well, and it has the better accuracy than the remaining other three above discussed algorithms.

It was assumed at some point of the discipline as spatial relationships, specifically heterogeneity and spatial autocorrelation, may additionally circulate an accomplishment function among explaining the function over monetary yet environmental elements affecting housing prices. Since it may also request after want exercise measured through the wide variety of transactions, the research was once conducted of several stages. An evaluation on spatial autocorrelation about both explanation yet explanatory variables was performed. Diagnostics concerning regression models had been in contrast with traditional models. Parameters regarding regression including rejoinder surroundings variables are shown within Table 3.

Figure 9. Comparison of housing market in three capital cities in India

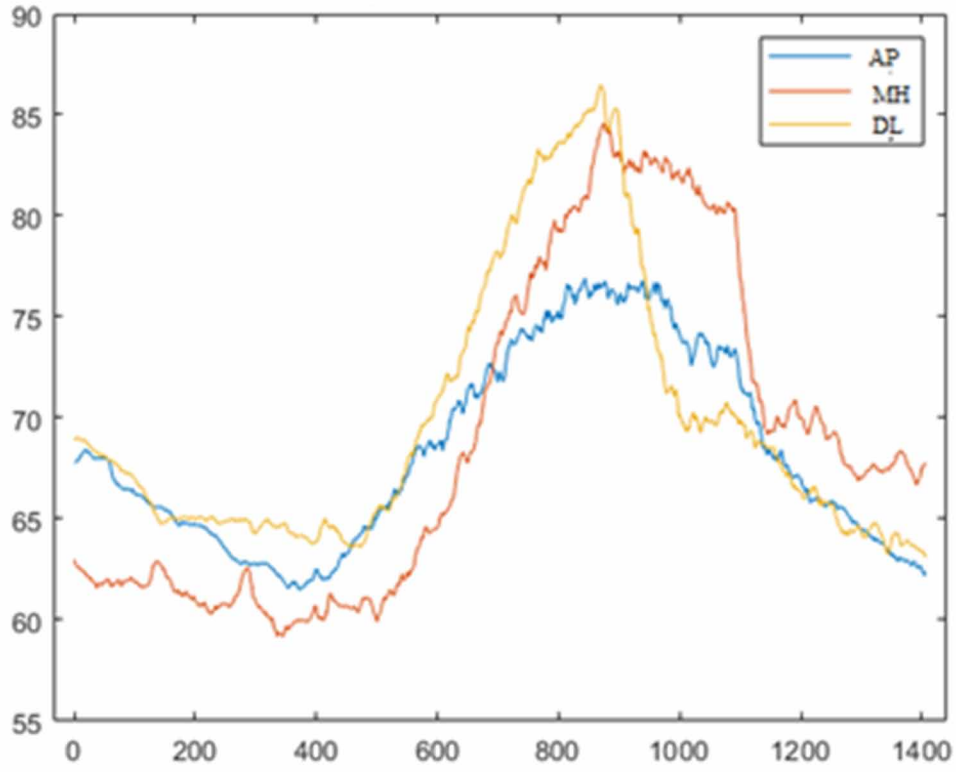
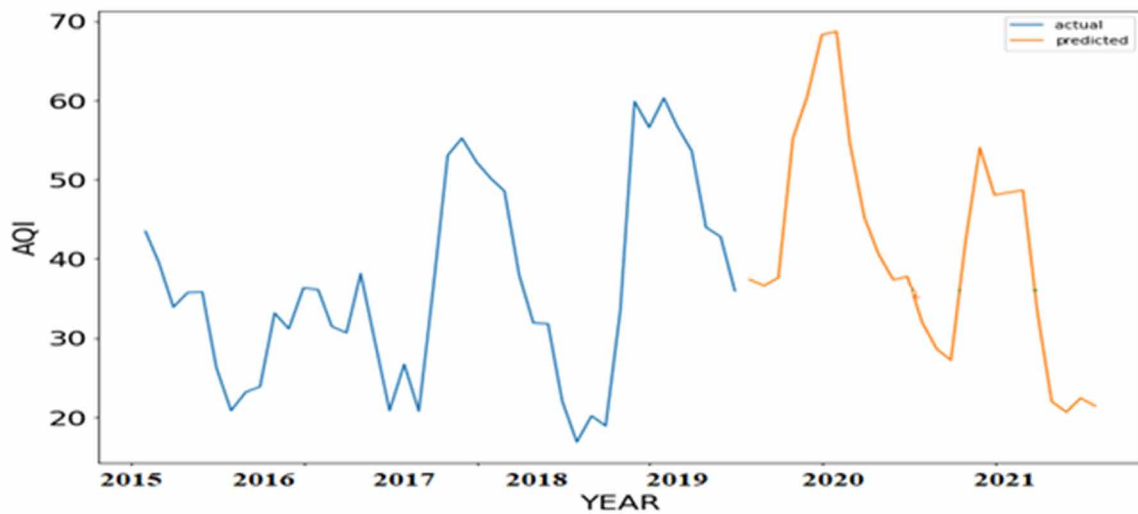


Figure 10. Prediction of housing market for the year 2021



Long-Term Effects of Climate Change on Housing Market analytics in Amaravati, Capital of Andhra Pradesh

Figure 11. a) Spatial distribution of pollutant PM2.5 concentration values, b) Spatial distribution of Housing Prices

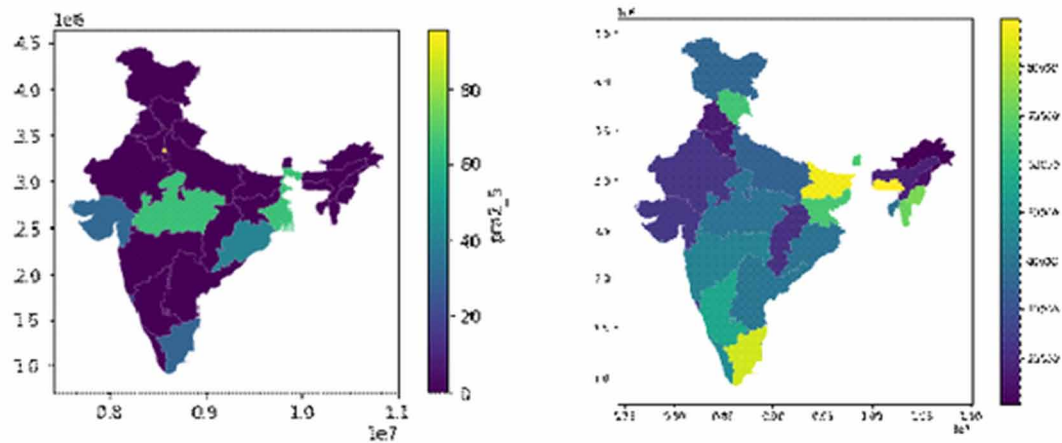


Figure 12. Comparison of different predicting systems

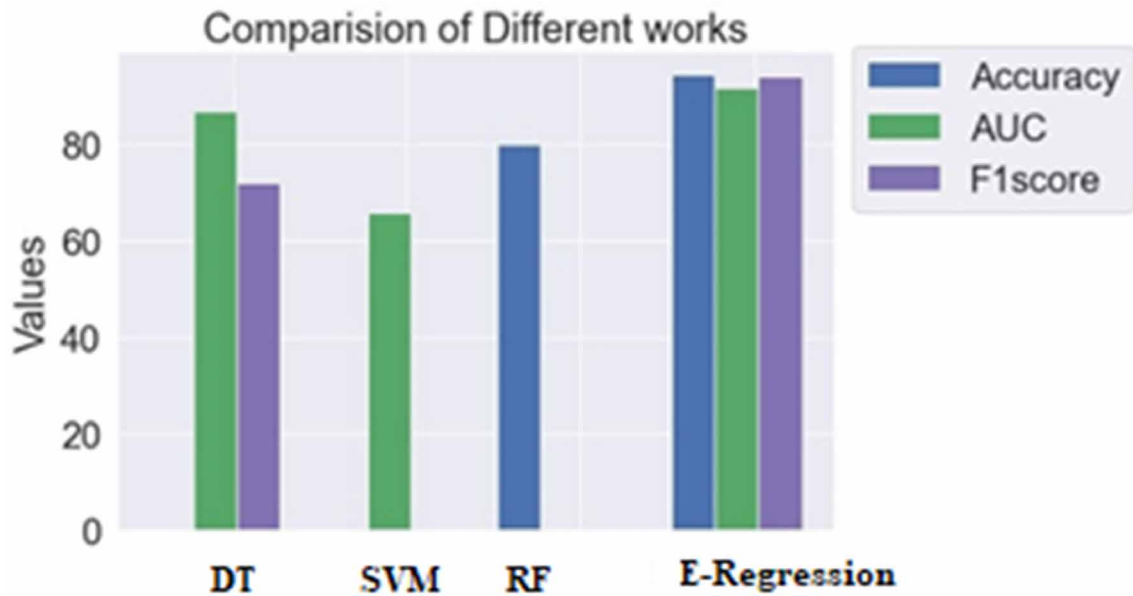


Table 3. E-regression values for the environment variables

	Estimated cost	error	ρ -value
V1	5274.500	2412.281	0.029
V2	0.170	0.074	<0.001
V3	62.591	18.842	0.002
V4	-113.473	36.894	<0.001
V5	-5.148	1.431	<0.001
V6	0.252	0.073	<0.001
V7	-16.627	11.420	0.146
V8	201.589	21.534	<0.001
V9	-26.221	28.738	0.362
V10	61.126	15.960	<0.001
V11	92.568	24.343	<0.001
V12	9.538	16.158	0.555
V13	0.003	<0.001	<0.001
V14	-0.553	0.126	<0.001

CONCLUSION

This study attempted to review the relationship between the environmental factors with the housing market in Amaravati region in India. This paper investigates specific models for housing rate prediction. Three kinds of machine learning strategies which include Support Vector Machine, Random Forest, Decision Tree, and choice tree are in contrast and analyzed for optimum solutions. Even though all these techniques completed perfect results, exclusive fashions have their very own pros and cons. Results exhibit the proposed technique can outperform the linear regressions with greater accuracy on look at set. This technique can additionally mirror the necessary have an impact on of region on housing prices, now not solely in the variations of essential elements affecting residence costs in distinctive areas however additionally on the distinctive outcomes of the equal variable on residence expenditures in exceptional regions.

REFERENCES

- Anselin, L., & Lozanogracia, N. (2008). Errors in variables and spatial effects in hedonic house price models of ambient air quality. *Empirical Economics*, 34(1), 5–34. doi:10.100700181-007-0152-3
- Antipov, E. A., & Pokryshevskaya, E. B. (2012). Mass appraisal of residential apartments: An application of Random forest for valuation and a CART-based approach for model diagnostics. *Expert Systems with Applications*, 39(2), 1772–1778. doi:10.1016/j.eswa.2011.08.077

- Bajari, P., Fruehwirth, J. C., Kim, K. I., & Timmins, C. (2010). A rational expectations approach to hedonic price regressions with time-varying unobserved product attributes: The price of pollution. *The American Economic Review*, *102*(5), 1898–1926. doi:10.1257/aer.102.5.1898
- Bayer, P., Keohane, N., & Timmins, C. (2009). Migration and hedonic valuation: The case of air quality. *Journal of Environmental Economics and Management*, *58*(1), 1–14. doi:10.1016/j.jeem.2008.08.004
- Boyle, M. A., & Kiel, K. A. (2001). A survey of house price hedonic studies of the impact of environmental externalities. *Journal of Real Estate Literature*, *9*(2), 117–144. doi:10.1080/10835547.2001.12090098
- Breiman, L. (2001). Random forests. *Machine Learning*, *45*(1), 5–32. doi:10.1023/A:1010933404324
- Carriazo, F., & Alexander, J. (2018). The demand for air quality: Evidence from the housing market in Bogotá, Colombia. *Environment and Development Economics*, *23*(2), 121–138. doi:10.1017/S1355770X18000050
- Chasco, C., & Gallo, J. L. (2015). Heterogeneity in Perceptions of Noise and Air Pollution: A Spatial Quantile Approach on the City of Madrid. *Spatial Economic Analysis*, *10*(3), 317–343. doi:10.1080/17421772.2015.1062127
- Chasco, C., & Sánchez, B. (2015). *Valuation of environmental pollution in the city of Madrid: An application with hedonic models and spatial quantile regression*. Rev. Déconomie Rég. Urbaine.
- Chattopadhyay, S. (1999). Estimating the demand for air quality: New evidence based on the Chicago housing market. *Land Economics*, *75*(1), 22–38. doi:10.2307/3146991
- Chau, K., Yiu, C., Wong, S., & Lai, L. W. C. (2003). Hedonic price modelling of environmental attributes: A review of the literature and a Hong Kong case study. In W. C. L. Lawrence & L. Frank (Eds.), *Understanding and Implementing Sustainable Development* (pp. 87–110). Nova Science Publication.
- Chen, D., & Chen, S. (2017). Particulate air pollution and real estate valuation: Evidence from 286 Chinese prefecture-level cities over 2004–2013. *Energy Policy*, *109*, 884–897. doi:10.1016/j.enpol.2017.05.044
- Chen, L., Yao, X., Liu, Y., Zhu, Y., Chen, W., Zhao, X., & Chi, T. (2020). Measuring impacts of urban environmental elements on housing prices based on multisource data – a case study of Shanghai, China. *ISPRS Int. J. Geo-Inform.*, *9*(2), 106.
- Chen, Y. W., & Chen, L. Z. (2012). Pricing for clean air: Evidence from Qingdao. *Japan and the World Economy*, *4*, 140–160.
- Das, P., Sah, V., Sharma, D., Singh, V., & Galuppo, L. (2013). Real Estate Development Process in India. *Journal of Real Estate Literature*, *21*(2), 271–292. doi:10.1080/10835547.2013.12090362
- De, U. K., & Vupru, V. (2017). Location and neighbourhood conditions for housing choice and its rental value: Empirical examination in an urban area of North-East India. *Int. J. Hous. Markets Anal.*, *10*(4), 519–538. doi:10.1108/IJHMA-10-2016-0072
- Fan, G. Z., Ong, S. E., & Koh, H. C. (2006). Determinants of house price: A decision tree approach. *Urban Studies (Edinburgh, Scotland)*, *43*(12), 2301–2315. doi:10.1080/00420980600990928

- Fu, X., Jia, T., Zhang, X., Li, S., & Zhang, Y. (2019). Do street-level scene perceptions affect housing prices in Chinese megacities? an analysis using open access datasets and deep learning. *PLoS One*, *14*(5), e0217505. doi:10.1371/journal.pone.0217505 PMID:31145767
- Harrison, D. Jr, & Rubinfeld, D. L. (1978). Hedonic housing prices and the demand for clean air. *Journal of Environmental Economics and Management*, *5*(1), 81–102. doi:10.1016/0095-0696(78)90006-2
- Hitaj, C., Lynch, L., McConnell, K. E., & Tra, C. I. (2018). The Value of Ozone Air Quality Improvements to Renters: Evidence from Apartment Building Transactions in Los Angeles County. *Ecological Economics*, *146*, 706–721. doi:10.1016/j.ecolecon.2017.12.022
- Izón, G. M., Hand, M. S., Mccollum, D. W., Thacher, J. A., & Berrens, R. P. (2016). Proximity to Natural Amenities: A Seemingly Unrelated Hedonic Regression Model with Spatial Durbin and Spatial Error Processes. *Growth and Change*, *47*(4), 461–480. doi:10.1111/grow.12147
- Jia, Y. (2014). *An Empirical Study on the Relationship between Urban Air Quality and Commercial Housing Price* (Master's Thesis). Tianjin Normal University, Tianjin, China.
- Kong, N. (2018). *Empirical Research on the Impact of Air Pollution on China's Real Estate Market* (Master's Thesis). Xiamen University, Xiamen, China.
- Kontrimas, V., & Verikas, A. (2011). The mass appraisal of the real estate by computational intelligence. *Applied Soft Computing*, *11*(1), 443–448. doi:10.1016/j.asoc.2009.12.003
- Law, S., Paige, B., & Russell, C. (2018). *Take a Look Around: Using Street View and Satellite Images to Estimate House Prices*. arXiv: 180707155.
- Li, H., Wei, Y. D., Yu, Z., & Tian, G. (2016). Amenity, accessibility and housing values in metropolitan USA: A study of Salt Lake County, Utah. *Cities (London, England)*, *59*, 113–125. doi:10.1016/j.cities.2016.07.001
- Li, J., Hu, Y., & Liu, C. (2020). Exploring the Influence of an Urban Water System on Housing Prices. *Case Study of Zhengzhou. Buildings*, *10*, 44.
- Li, M. M., & Brown, H. J. (1980). Micro-neighborhood externalities and hedonic housing prices. *Land Economics*, *56*(2), 125–141. doi:10.2307/3145857
- Lieser & Groh. (2011). The Determinants of International Commercial Real Estate Investments. *IESE Business School*, 935.
- Ligus, M. (2018). Measuring the Willingness to Pay for Improved Air Quality: A Contingent Valuation Survey. *Polish Journal of Environmental Studies*, *27*(2), 763–771. doi:10.15244/pjoes/76406
- Mittal & Bhargava. (2014). *Advocates & Legal Consultants: An Overview on Indian Real Estate*. Academic Press.
- Montero, J. M., Minguez, R., Fernandez, A., & Fernandez-Aviles, G. (2018). Housing price prediction: Parametric versus semi-parametric spatial hedonic models. *Journal of Geographical Systems*, *20*(1), 27–55. doi:10.1007/10109-017-0257-y

Long-Term Effects of Climate Change on Housing Market analytics in Amaravati, Capital of Andhra Pradesh

- Murdoch, J. C., & Thayer, M. A. (1988). Hedonic price estimation of variable urban air quality. *Journal of Environmental Economics and Management*, 15(2), 143–146. doi:10.1016/0095-0696(88)90014-9
- Neelawala, P., Wilson, C., & Athukorala, W. (2012). The impact of mining and smelting activities on property values: A study of Mount Isa city, Queensland, Australia. *The Australian Journal of Agricultural and Resource Economics*, 5(7), 60–78.
- Nelson, J. P. (1979). Airport noise, location rent, and the market for residential amenities. *Journal of Environmental Economics and Management*, 6(4), 320–331. doi:10.1016/0095-0696(79)90011-1
- Nourse, H. O. (1967). The Effect of Air Pollution on House Values. *Land Economics*, 43(2), 181–189. doi:10.2307/3145241
- Ramprakash Kona, Rao, & Prasad. (2016). Trends in Indian Realty Sector - A CRM Framework for Real Estate Entities in the Changing Environment. *International Journal of Innovative Research and Development*, 5(7), 165–175.
- Ranjan, S. (2013). Indian real estate: the year gone by and outlook. EY.
- Ridker, R. G., & Henning, J. A. (1967). The determinants of residential property values with special reference to air pollution. *The Review of Economics and Statistics*, 49(2), 246–257. doi:10.2307/1928231
- SDC Companies Development Services. (2015). *MGT Radiance*. Author.
- Selim, S. (2008). Determinant of House Price in Turkey: A Hedonic Regression Model, Dogus. *Universities Dergisi*, 9(1), 65–76. doi:10.31671/dogus.2019.223
- Smith, V. K., & Deyak, T. A. (1975). Measuring the impact of air pollution on property values. *Journal of Regional Science*, 15(3), 277–288. doi:10.1111/j.1467-9787.1975.tb00931.x
- Sullivan, D. M. (2016). *The True Cost of Air Pollution: Evidence from House Prices and Migration*. Harvard University. Massachusetts Hall Cambridge.
- Tan, J., & Zhao, J. (2014). The value of clean air in China: Evidence from Beijing and Shanghai. *Frontiers of Economics in China*, 9, 109–137.
- Thomas, A. (2015). *Why is Hyderabad's Residential Market not yet booming?* Academic Press.
- Tian, G., Wei, Y. D., & Li, H. (2017). Effects of accessibility and environmental health risk on housing prices: A case of Salt Lake County, Utah. *Applied Geography (Sevenoaks, England)*, 89, 12–21. doi:10.1016/j.apgeog.2017.09.010
- Topco, M., & Kubat, A. S. (2009). Konut bölgelerinde Mekansal Yapı. *Arazi Değer İlişkisi*, (332), 17–26.
- Vapnik, V. (1995). *The Nature of Statistical Learning Theory*. Springer. doi:10.1007/978-1-4757-2440-0
- Wadhvani. (2009). *Opportunities and Challenges of investing in Indian Real Estate*. Academic Press.
- Wang, S., & Shi, J. (2019). Study on regional difference of air quality's impact on urban housing price. *Prices Mon.*, 10, 14–21.

Long-Term Effects of Climate Change on Housing Market analytics in Amaravati, Capital of Andhra Pradesh

- Wang, X. J., Zhang, W., Li, Y., Yang, K. Z., & Bai, M. (2006). Air quality improvement estimation and assessment using contingent valuation method, a case study in Beijing. *Environmental Monitoring and Assessment*, *120*(1-3), 153–168. doi:10.1007/10661-005-9054-z PMID:16770506
- Wang, Y., Wang, S. J., Li, G. D., Zhang, H. G., Jin, L. X., Su, Y. X., & Wu, K. M. (2017). Identifying the determinants of housing prices in China using spatial regression and the geographical detector technique. *Applied Geography (Sevenoaks, England)*, *79*, 26–36. doi:10.1016/j.apgeog.2016.12.003
- Wieand, K. F. (1973). Air pollution and property values: A study of the St. Louis area. *Journal of Regional Science*, *13*(1), 91–95. doi:10.1111/j.1467-9787.1973.tb00380.x
- Yalpir, S., Durduran, S. S., Unel, F. B., & Yolcu, M. (2014). Creating a Valuation Map in GIS Through Artificial Neural Network Methodology: A Case Study. *Acta Montanistica Slovaca*, *19*, 89–99.
- Yoo, S., Im, J., & Wagner, J. E. (2012). Variable selection for hedonic model using machine learning approaches: A case study in Onondaga County, NY. *Landscape and Urban Planning*, *107*(3), 293–306. doi:10.1016/j.landurbplan.2012.06.009
- Yu, D., & Wu, C. (2006). Incorporating Remote Sensing Information in Modeling House Values. *Photogrammetric Engineering and Remote Sensing*, *72*(2), 129–138. doi:10.14358/PERS.72.2.129
- Yusuf, A. A., & Resosudarmo, B. P. (2009). Does clean air matter in developing countries' megacities? A hedonic price analysis of the Jakarta housing market, Indonesia. *Ecological Economics*, *68*(5), 1398–1407. doi:10.1016/j.ecolecon.2008.09.011
- Zabel, J. E., & Kiel, K. A. (2000). Estimating the demand for air quality in four U.S. cities. *Land Economics*, *76*(2), 174–194. doi:10.2307/3147223
- Zhang, B., & Huang, X. (2017). Peking University A price evaluation of air quality in China. *Res. Econ. Manag.*, *38*, 94–103.
- Zhang, F., Zu, J., Hu, M., Zhu, D., Kang, Y., Gao, S., Zhang, Y., & Huang, Z. (2020). Uncovering inconspicuous places using social media check-ins and street view images. *Computers, Environment and Urban Systems*, *81*, 101478. doi:10.1016/j.compenvurbsys.2020.101478
- Zhang, H. Y., & Wang, X. Y. (2016). Effectiveness of Macro-regulation Policies on Housing Prices: A Spatial Quantile Regression Approach. *Hous. Theor. Soc.*, *33*, 23–40.
- Zhang, X., Zhang, X. B., & Chen, X. (2017). Valuing Air Quality Using Happiness Data: The Case of China. *Ecological Economics*, *137*, 29–36. doi:10.1016/j.ecolecon.2017.02.020 PMID:28989234

Chapter 21

Nexus of Green Management, Green Marketing, Sustainability, and Financial Performance

Adenike Oyelola Soogun

Management College of Southern Africa, South Africa

ABSTRACT

Consumer and organizational awareness of environmental sustainability is ever increasing. In the era of global warming and climate change, organizations need to move away from traditional marketing strategies to green marketing strategies and green management to remain sustainable. The objectives of this chapter are to provide stakeholders with the overview and importance of green marketing, establish the link between green marketing mix and strategic green marketing, and reveal what organizations should focus on in developing green management to remain competitive and profitable. Green marketing strategies activities for financial services were highlighted, and lastly, the authors examined the impact of green management on firm financial performance. The chapter offers a holistic practice and recommendation of going green for both financial services and other businesses. Practical implications for managers were pointed out through commitment to green marketing and management to yield positive outcomes on firm financial performance in the long run.

INTRODUCTION

Green marketing strategies is a vital impetus for every organisation to achieve their goals, remain relevant, competitive, and sustainable. Traditional marketing approach is no longer sustainable in this epoch of global warming. Consumers are becoming more conscious of the product they buy which has necessitate more awareness of green marketing and green management practice by organisations locally and globally. Therefore, for all sectors of industry, in today's business it is "GO GREEN or GO HOME", is no longer business as usual.

This chapter aims to outline the concepts, need for the implementation, benefits, strategies, as well as understanding the impact of green marketing and green management to remain relevant, competitive, and

DOI: 10.4018/978-1-7998-7967-1.ch021

sustainable. Current literatures were explored, and recommendations were provided for today's businesses and managers as they focus on increasing their financial performance in the quest for climate change.

BACKGROUND AND OVERVIEW OF GREEN MARKETING

Climate change has revolutionized companies into innovative development of green management. All business activities from human resources, sales and marketing, technology, production, supply chain, and finance are taking a paradigm shift from traditional way of doing business. Business processes from all sectors are being reengineered to conform to the move of going green.

Dahlstrom (2010) defines green marketing as the study of all efforts to consume, produce, distribute, promote, package, and reclaim products in a manner that is sensitive or responsive to ecological concerns”, and “the development and marketing of products designed to minimize negative effects on the physical environment. Karna, Hansen & Juslin (2003) affirmed that green marketing is a tool that firms use to gain monetary goals by fulfilling buyers' demands and needs that are derived from society's changing environmental awareness. Furthermore, Ranjan (2020), posit that green marketing relates to “the satisfaction of the needs and wants of the consumers with a minimum impact on the environment.

However, from the financial sector perspective, Evangelinos, Skouloudis, Nikolaou & Filho (2009) described green marketing *as* the development of green financial products, such as loans that finance cleaner technology and the implementation of environmental strategies, such as energy efficiency and waste management programs, that improve banks' environmental performance and reputation. Few studies have been carried out to explore the notion of green marketing in the financial sector. Lymperopoulos, Chaniotakis & Soureli (2012) explored green marketing model in a financial sector by providing a framework that service providers may adopt in order to implement a green marketing strategy. They suggested that service organizations should design new processes that require fewer resources as inputs and place fewer demands on the environment. Millat, Chowdhury & Singha (2012) discussed the emergence of green banking in Bangladesh to foster sustainable environmental growth through implementation and development of green banking activities in the country. Similarly, Rahman, Ahsan, Hossain & Hoq (2013) opined that banks can go green by bringing changes into six core banking activities, such as Change in the Investment Management, Change in Deposit Management, Change in Housekeeping, Change in the process of Recruitment and Human Capital Development, Corporate Social Responsibility (CSR), and Making Consciousness Among Clients and General Mass.

Therefore, green marketing is part of detailed business strategies (Prakash, 2002). Therefore, it can be said that green marketing is closely related both to business strategies and public order. Business entities can make themselves green through three ways: value addition process (at company level), management systems (at company level) and their products (at product level) (Dahlstrom, 2010).

BENEFITS/ IMPORTANCE OF GREEN MARKETING

In today's economy different stakeholders are recipients of green marketing benefits. As highlighted by Dahlstrom (2010) these stakeholders are the environment, consumers, developing and developed economies, the product, supply chain process, corporate strategy, and production processes.

The Environment

Environment is a clear benefactor of green marketing. The supply of electricity through burning of coal and supply of automobile transport system through burning of gasoline are two major sources of climate change. Therefore, initiation of green marketing activities through the development of green products and process has reduce the need to rely on these forms of energy supply. For example, use of solar energy for electricity supply and development of hybrid electric cars, which at the long run reduces air pollution (Dahlstrom (2010)).

Developing Economies

Countries with low gross domestic per capita (GDP), are referred to as developing nations. Attributed to low income, unemployment economic vulnerability, and many more, forces people in these economies to highly dependent on agriculture and small-scale enterprises. However, faced with lots of environmental stress and limitations. Development of new green technologies in such economy will enhance business productivity and advancement with less stress. According to Akanwa & Joe-Ikechebelu (2019), 30% of Nigerian companies are environmentally friendly, awareness and information on green marketing principles are not adequately shared. Thaker, Smith and Leiserowitz (2020) opined that risk perception of global warming in Indian are both similar and different to that of developed nations, which has a key implication to climate change communication among the people. In the long run, these countries are benefactor of green economy as quality of life is improved.

Developed Economies

Developed economies are nations with moderate to high GDP. According to United Nations Development reports of 2019, top 10 developed countries based on their Human Development Index (HDI) are Norway, Switzerland, Ireland, Germany, China, Australia, Iceland, Sweden, Singapore and the Netherlands. Others include United State of America, Japan, and Russia. These nations are characterised with advance technology, infrastructure, and diverse industrial and service sectors. Ragnhild, Fuglestedt, Berntsen, Peters, Andrew, Allen & Kallbekken (2017) affirmed that availability of these advance technologies and infrastructure position these countries as the largest contributors and mitigators to global warming. Thereby, making these nations to divert from outdated technologies and embraces innovative one for the developed market they operate in.

Consumer Benefits

Green marketing fosters brand loyalty. Consumers are benefactor of green marketing in the sense that they have the awareness and knowledge of being part of the climate change effort. Also, the sense of being associated with biodegradable products, projects, and organisation (Kent & Stone, 2007). Consumers want ecologically friendly products without sacrificing other valuable features. For example, the LCD monitors marketed by Dell offer substantial savings over the CRT monitors currently being phased out of the product line. These new monitors are less expensive, energy efficient and employ the more recent computer display technology (Ragnhild et al, 2017).

Product and Process Benefits

Product benefit is the introduction of a particular unique and valuable components designed to benefit the consumer, whereas process benefits is as a result of tools, devices, technology throughput knowledge to facilitate logistics and manufacturing process. For example, hybrid engine is a product benefit and innovation while Just-in-time (JIT) inventory system, click & collect, and drive thru are process innovation.

Generally, green products result in customers satisfaction as well as improve the quality of the environment.

Production Process Benefits

As explained by Dahlstrom (2010), producing highest quality products, and rendering best service at lowest possible cost is the competitive and leadership focus of industries. Since overall production goal is to save energy, space and be profitable, material costs associated with overall costs and sustainable manufacturing approaches can be reduced through JIT.

Bob (2007) further posits that green production helps in the reduction of greenhouse gas emission as well as decrease in mercury and nitro oxide emissions, which at the long run lowered fuel cost and business can earn revenue from hydrochronic acid sales as well low-pressure steam to ethanol plant.

Strategic Benefits

Multiple benefits have been realised from green marketing by managers from corporate strategy point. Ottman (2011) opined that conscious and intentional adoption of green strategic goals into the corporate, business, operations strategy and transactional strategy of companies in this period of climate change will enhance their images among all stakeholders (consumers, investors, supply chain etc) and participants .

Chengli, Mengli, Jinxin & Lindsay (2020) affirmed that continuous improvement in environmental performance and responsibility is one strategic benefit green marketing brings to the organisations goal. This thus allow firms to gain deep understanding of how they are affecting the environment as well as how the environment is affecting them. This in turn reveals to the firm's risk associated with their financial obligations.

Supply-Chain Benefits

Different level of relationships occurs among firms that make of the supply chain channels (from sourcing of raw material to final consumption of goods), which can be influenced by green marketing. For example, green strategies that seeks to eliminate waste results in analysing truck loading and planning of route in the delivery process with overall goal of reducing delivery cost. Likewise, by maximising truck capacity utilisation and improving customer service, route can be plan in eliminating fuel costs. A level of insurance is also provided with the adoption of sustainable or green strategies for production and distribution of food products.

EFFECT OF GREEN MARKETING MIX ON FIRMS' SUSTAINABILITY

Most crucial need of this present age is to save our environment. According to Kotler and Kotler (1997), marketing mix are the ways company uses to deliver goods and services to the market. The traditional marketing mix comprises of the popular 4P's known as product, price, place, and promotion. However, in the case of service organisation, we saw the extended 7P's marketing mix where people, process and physical evidence were added. Conversely green marketing mix philosophy will have to respond to environmental concerns, whereby each of the marketing mix must have green outlook and green focus from development to final stage.

Therefore, green marketing mix is a strategy for sustainable development for all business organisations. It has a significant effect on customer satisfaction as well as give organisation overall competitive advantage. Some of these green marketing mix and their philosophy are discussed below:

Green Product

Eneizan & Wahab, (2016) stated that a product is termed green, if its production process is climate-friendly and less harmful to the environment. These are products that do not pollute the environment, expend natural resources, can be reuse and recycle (Shamdasani et., al., 1993). Ottman, Stafford & Hartman, (2006) posit that in today's business world, the use of product that can create or maintain natural environment through energy and resources protection; lowering or eliminating waste and toxic substances should be the focus of businesses. Every business is responsible for reducing the environmental pollution in its production process. The raw materials must be obtained in such a way that natural resources are preserved. Business must develop an eco-friendly design and a packaging that minimizes pollution and hazards. The sunk costs of product improvements are substantial; nevertheless, these costs are justifiable because they are likely to boost product sales. Reverse logistics (i.e., a technique in which customers return to the business used packaging, wrapping, and even the used product itself) would significantly aid in preserving the environment (Arseculeratne & Yazdanifard, 2014).

In the development of green products, Sachs, Woo, Yoshino & Taghizadeh-Hesary (2019) posit that the issue of sustainability is a supportive factor and a strong a link which cannot be over emphasised. Therefore, sustainability in this light, denotes a deliberate and conscious minimization of the ecological impact and increase use of green materials. Green product sustainability conveys the concept of 6R, which are: recover, reuse, recycle, redesign, reduced and remanufacture Lu, Ye, Chau & Flanagan (2018). Tseng & Hung (2013) affirmed that customers are increasingly showing concern toward purchase of green product, willingness to pay more for such products and interested in green services. Therefore, key to the success of organizations is their capacity to fulfil customer needs and wants, particularly those that pertain to the environment. No product has zero impact on the environment. However, the aim in green marketing concept is to minimize this effect.

Additionally, Eneizan and Wahab (2016) formulated the green product concept on the "4S", namely: ***Satisfaction*** (satisfying the needs and desires of consumers), ***Sustainability*** (ensuring the continuity of a product's energy and resources), ***Social acceptability*** (being accepted as a product or an enterprise about being not harmful to the environment or living things), ***Safety*** (not jeopardizing the health of individuals). According to the 2007 report of the North American Task Force (NATF) of the United Nations Environment Programme Finance Initiative highlighted current and future opportunities of developing green products and service in financial sector such as banks. Customer demands is on the rise for green

financial products and services, especially in countries like North America, Europe, Japan and Australia. This was said to be driven by three overarching factors: environmental knowledge & media coverage, environmental awareness, environmental awareness & public opinion and environmental regulation & legislation.

Many studies have shown that green product provides some benefits to the brand. For example, it ensures price positioning over market value, prevents information tangle, protects against competitive attacks, raises productivity, and creates loyalty in the consumer.

Some examples of green production are:

1. Energy saving refrigerator (with built in inverter), Dish washer (less energy and water consumption), LED lightning (save energy and durable) (Tseng & Hung, 2013).
2. Nokia's new model cell phones alert for unplugging the charger from the socket when the battery is full. (Eneizan & Wahab, 2016).
3. Use of paper bags as against plastic packages (Bedo, 2018).

Green Price

A significant and vital element of the green marketing mix is price. This is paying for additional value the product offers, which include additional performance, functions, designs, appearance, benefits, often used as a factor for customer satisfaction, product quality and sustainability. A premium price that further increases cost promotion is referred to as green price (Eneizan et., al. 2016). However, the process of going green is expensive which are consolidated into the final price of a product. This process could involve installation of new technology and equipment, employee training, redesign, and reengineering.

In the long run, consideration is given to both economic and environmental cost of marketing and production, while simultaneously providing value to customers and profitability on business. (Martin & Schouten, 2012). Looking at both tactical and strategic perspective of green pricing, tactically, it can be deduced that firms should undertake pricing actions such as rebates for returning recyclable packaging and charging higher prices for non eco friendly products. For examples, Mac gives a lipstick free when you recycle any four containers of their products. The use of biodegradable shopping bags (Belz & Peattie, 2009). Bank customer paying no service fee for using online services and products. While from the strategic point of view, use of life-cycle costing approach (incorporating product costs from research to disposal). Intuitively, price of green product reduces once consideration is given to product life cycle (Larashanti et., al. 2012). Manjunath & Manjunath, 2013 stated that implementation of green marketing is also beneficial to companies as the initiative resulted in competitive advantage and value propositions. Evidently, Leonidou et., al (2013) revealed that effective green pricing strategy have significant financial performance on return on assets (ROA) of firms.

Green Promotion

Another vital element of green marketing mix is promotion. This is referred to as the process of communication that helps build a lasting relationship with customers while informing and persuading the purchase of green products. The goal of promoting products or service is for connectivity, building strong environmental image and transferring service-related marketing messages (Manjunath and Manjunath (2013). Traditional promotional mix elements involve use of advertising, sales communication, personal

Nexus of Green Management, Green Marketing, Sustainability, and Financial Performance

selling, public relations activities, and direct marketing to facilitate marketing messages (Al-Salaymeh M, 2013). Whereas green promotion includes execution of those promotional mix activities with focus on environment consciousness. As stated by Arseculeratne and Yazdanifard, (2014) the two focus of green advert are promulgating the products and rationalizing their features.

As stated by Arseculeratne and Yazdanifard (2014), examples of green promotions are,

1. Use of digital coupons.
2. Use of digital platforms (online) such as google video, You tube, online banking, cell phone banking etc.
3. Use of reusable material for promotional gifts.
4. Use of digital notifications to consumers.

As businesses become conscious of protecting the environment, the green movement comes with green messages during advertisement. Larashati et., al. (2012), Dash and Das (2012), hereby encourages marketers and firms to be smart green and utilize green marketing communication tools and practices to reinforce their environmental credibility. Several companies have adopted this guideline.

As highlighted by Kırğız and Erdemir (2013), Arseculeratne and Yazdanifard (2014), Hasan and Ali (2015), some green messages which have been highlighted in ads are:

1. “our product is made from materials that save life, resources and energy.
2. “reuse, reduce and recycle”.
3. “simply organic”.
4. Green message affirms the manufacturing, distribution, packaging, recycling and disposal policies.
5. Address universal consumer problems.

Convincingly, firm can obtain a considerable financial and public support when they combine their green policy and green product design with green message.

Green Place

One crucial factor in consumer purchase behaviour is the knowledge of where and when the product will be available (Dash & Das, 2012). Customers are not ready to travel to unknown places even if the products are available. Consumer’s expectation can be easily measure and accessible in the marketplace. To remain competitive, marketers must position their product and service is the heart of consumers. Location matters in all businesses as it speaks the company image and aids in differentiation strategy from competitors.

STRATEGIC GREEN MARKETING MANAGEMENT IN PRACTICE

Green marketing management “is the process of planning and executing the marketing mix to facilitate consumption, production, distribution, promotion, packaging, and product reclamation in a manner that is sensitive or responsive to ecological concerns” (Dahlstrom, 2010). The planning process involves anticipating future conditions and establishing strategies to achieve objectives. Firms that incorporate

sustainability concerns into strategic planning recognize that the activities and programs developed by the firm simultaneously influence the environment. For example, Toyota recognizes that gasoline prices represent a facet of the environment that influences consumer purchase decisions. In addition, Toyota also considers the influences of automobile production and operations on the environment. This means that firms green planning process entails examining the relationship and correlation between the environment and its corporate strategy with the focus of profitability.

The big question now is, “what is the difference between traditional strategic marketing planning and green marketing planning?” Furthermore, Dahlstrom (2010), define green marketing planning as “*the process of creating and maintaining a fit between the environment and objectives and resources of the firm*”. The term “fit” in this case looks at the efforts firm must make to understand how the environment they operate both influences them and how marketing activities influences their decisions. As explained by Baker (2014) strategic green planning process begins with an in-depth SWOT analysis of the internal and external environment of the firm, follows by establishing its mission, objectives, strategy, implementation, and evaluation.

Implementation of strategic green products and services in banks and other financial sectors is vital to remain competitive and be socially responsible. This must be taken as a component of the “cultural fabric” that constitute the organizational structure. By directing their resources and lending power to reduce ecological degradation as well as indorsing practices and decisions to foster global warming in this 21st century is the only way to be sustainable.

As explained by Zhang et., al. (2011), the concept of green marketing strategy is referred to marketing policies, practices, and procedures that are aligned with ecological responsiveness and/or that eliminate or reduce adverse impacts on the planet and people. Furthermore, Al-Salaymeh (2013) posit green marketing strategy, as set of marketing tools and elements, allows a firm to serve the target market and achieve organizational goals without harming the natural environment. Gopalakrishnan & Muruganandam, (2013) stated that, it facilitates product sales, as active involvement in environmental protection motivates family and friends to purchase green products, thus furthering the sustainable development in the country. Mukonza & Swarts (2019) agreed that establishing green management have positive effect on company image and business performance. Therefore, recommended the adoption of green marketing strategies to be sustainable.

Green marketing strategy emanated from the top to the bottom. It encapsulates the totality of the company environment, structure, and activities. The strategy begins with the firm incorporating green perspective and culture into its mission and vision statement, unto assuring all stakeholders of the organisation green consciousness and readiness to be eco-friendly and be sustainable. The next section discussed some strategic green management approaches for today’s organisations in the climate changing world.

Green Vision and Mission Statement

Mission statement describes a firms fundamental, unique purpose, indicating what the organization intends to accomplish, the markets in which it operates, and the philosophical premises that guide its actions. It is an inspirational tool that provides motivation, direction, and insight into the company’s culture.

Senior management establishes the mission which provides a sense of direction to the organization while employees and business partners are inspired to pursue specific action because the action is consistent with the message outlined in the mission. For organizations to have a strategy that meaningful incorporates green marketing and sustainability, they must have a mission and vision statement that

integrate green marketing and sustainability practices. For example, P&G (Procter and Gamble) incorporates an external focus into its core principles for operations. The firm recognizes that this external orientation requires the company to incorporate sustainability into its products, operations, and packaging. The company follows through with this commitment in several ways. First, P&G has adopted a sustainability perspective focused on improving lives for years to come. Second, the firm has a product safety initiative designed to enhance the environmental quality of products, packaging, and operations across the globe. Third, P&G has implemented a commitment to the environment. Since detergents and other products that the firm manufactures can have a significant influence on water and water treatment plants, P&G requires all ingredients to pass an environmental risk assessment before they can be integrated into products. These commitments to the environment flow from a corporate mission that emphasizes environmentalism and sustainability.

In the current business operations and regulatory the climate, firms should also recognize that public statements about efforts to become sustainable subject the firm to greater scrutiny. In a global enterprise, these statements open the firm to criticism from consumers and government organizations. For example, Coke and Pepsi are two global consumer products companies that each developed commitment to sustainability. These firms and their affiliated bottlers necessarily must account the way water is treated in the production process. Each firm expressed commitment to sustainability has been accompanied by critiques in some markets about water filtration and handling (Brady, 2010).

Green Label (Eco-Labeling)

Green labelling is the certification issue to company's based on green practices in their environment. As described by Yağcı & Özcan (2008), companies are usually assessed based on some environmental checklist criteria as specified by either local or international compliance body known as international Standardization Organisation (ISO). According to their compatibility to the environmental regulations and policy, a label is received as a proof and companies displays this on their products and all platforms for easy identification. Emgin & Türk, (2004) further explained that green labelling addresses both the environmental consciousness of the consumer and supports the manufacturers for pushing their limits for an environmentalist attitude. Green labeling enhances consumers sensitivity for healthier and safe environment as well as ensure they are preferred for not using toxic materials.

As highlighted by Yağcı and Özcan (2008), a series of standards has been developed by ISO, with the provision of three different environmentalist label as follows:

1. **Conformity seal label:** Companies get this tag once they meet a series of specified requirements. These requirements are for different product categories with regards to the environmental situations. The label is represented with a logo which is placed on the product packages.
2. **Self-explanatory labels:** Companies makes declaration and explain the green performance of the product. Typically, these labels state the status of the products in focus to the environment.
3. **Green product statement:** This statement provide data regarding the environment about a product. The company that manufactures the product presents the statement and usually get certified by a third parties. This comes in form of a pamphlet instead of a simple logo or label.

Green Packaging

Packages are outer cover that protect products against external or physical effects, provide important and convenient information to consumer and sellers (Zhang & Shen, 2011). A green packaging is one made to stop waste, eco-friendly, not toxic and recyclable (Kırgız & Erdemir, 2013). Disposition of packaging and various products wraps has become one of the big issues to environmental friendliness. Indissoluble and unrecyclable packages or products is one significant causes of climate damage. Therefore, as mentioned by Kirgiz (2016), based on sustainable cognizance, package of a product should comply with the following fundamentals elements:

1. Package's volume and weight must be kept at minimum proportion.
2. In both manufacturing and use of packages, their energy depletion must be minimal.
3. use of recyclable materials such as glass bottles.

Therefore, it is worth noting to every financial, business, industry, and marketing managers that “packaging is an important aspect of manufacturing costs, which should be cost effective. As a result of increase in global warming threat, this have made government to make legal regulations guiding and protecting the environment. In a nutshell the focus of green packaging must be reduce, reuse, recycle and retrieve.

THE LINK BETWEEN GREEN MARKETING STRATEGY AD GREEN MARKETING MIX

As posed by Eneizen & Wahab (2016), managers are faced with two big questions as regards green marketing strategy. First, can they raise enterprise revenues by increasing the perceived green level? Do the enterprise suffer financial loss if consumers perceive the enterprise green at an insufficient level? Or are too many consumers concerned about the capability of the enterprise for offering green-compatible services? Second, can the brand or the enterprise be differentiated at the green dimension? Has the enterprise got any understanding about what being green means and a decisiveness about being green at management level? Can competitors be coped with at this dimension, or would it be a very expensive and disappointing situation to compete on environmental issues with enterprises that are green at advanced level in this field?

Answers to the above questions will determine how far a firm will go with respect to their green business, and how they can be easily differentiated.

As illustrated by Arseculeratne & Yazdanifard (2014), green marketing involves establishing a link between the business and customer. A green marketing strategy brings about a qualitative change in the relationship between customers and a business organization. The proactive approach in Green marketing is aimed at gaining competitive advantage by strategically positioning the products in the minds of customers. In Khan Royhan, Rahman, Rahman, & Mostafa (2020) recent study, a model was developed which reveals that green marketing mix and eco-labeling strategies transmit the effect of enviropreneurial orientation to business performance of small firms”. More specifically, this relationship amplifies the ‘green’ dominant decision-making process for a small firm with its effect on profit, the planet, and people. The model conceptualizes enviropreneurial orientation as a focal construct which influences

the green marketing mix strategy, eco-labeling strategy, and business performance of small firms. In this relationship, green marketing mix and eco-labeling strategies play the key mediating role between enviropreneurial orientation and business performance of small firms. Enviropreneurial orientation was referred to as manager/owner's inclination towards the environment and business that leads to environmental and business goals, inspiring proactive, innovative, risk taking and the aggressive design and execution of ecological policies and plans that immediately increase the firm's competitive position and business results (Aykol & Leonidou 2014). Lastly, Parpadas et., al. (2019) highlighted that strategic green marketing orientations (SGMO) positively affect competitiveness, and this mediates the relationship of SGMO with financial performance.

GREEN MARKETING ACTIVITIES FOR SUSTAINABLE FINANCIAL SERVICES

Green financial service means promoting environmentally friendly practices and project, as well as reducing carbon footprint from financial service activities (Raad, 2015). Global warming practice in financial sector means looking at those green marketing activities the financial services business can engage in to remain sustainable. However, because the concept is new in the financial service, few studies has been done compared to manufacturing and retail sector, howbeit some financial institution has proposed some of the green activities for future adoption.

According to Noh (2010), Miroshnychenko, Barontini & Testa (2017) and as stated in 2007 report of the North America Task Force (NATF) of the United Nations Environment Programme Finance Initiative, financial service sectors can be divided into sub sector as: 1) Retail banking; 2) Corporate & Investment banking; 3) Asset Management; and 4) Insurance. These sub sector have peculiar green products and services that firms must target to remain sustainable.

Green Retail Banking

Retail banking focuses on personal and business products and services for individual, and small and medium enterprises, instead of large corporate or institutional customers.

As described by Rakic & Mitic (2012) examples of green products and service for retail clients include, green loans, green home mortgage, green debit and credit cards services, green certificates of deposit, money order and overdraft, cash management service and insurance, among others.

1. **(a). Green Mortgage:** Banks provides green mortgages by financing the costs of moving from traditional to green power and energy supply. Also, customers that are engaged in Green mortgage (Energy Efficient Mortgages EEMs) gets lower interest rate. In North America, clients are emerging by engaging on green commercial building.
2. **(b). Green credits and debits cards:** Green credit cards allow customers to offer donations through a percentage point on every purchase, balance transfer or cash advance to some NGOs. Examples of green cards that has been developed in North America are: Shorebank Pacific's Salmon Nation Platinum Visa, Citigroup's Environmental Defence Platinum Master Card and others.
3. **(c). Green Deposit:** In Australia, Westpac is first bank to develop a range of innovative green products to support personal, busines and corporate banking. Westpac customers are encouraged

to directly support domestic farmers and sustainable agriculture by signing up for a Landcare Term Deposit Account.

4. **(d). Green car loan:** Green car loans are prominent in Europe and Australia, where clients enjoy interest rate lower than average car loan.
5. **(e). Green certificates of Deposits (CDs):** These are issued to investors in energy efficient and environmental projects, money from CDs is used to finance diverse solar energy projects which attract higher interest rate than regular investments.

These products improve environmental protection activities, such as clean energy and high fuel efficiency activities.

Green Corporate and Investment Banking

Corporate and investment banking also known as wholesale banking seeks to provide supports to large institutions, governments and other public organisations with financial needs that are complex, advance and on global scope. As mentioned by Miroshnychenko et., al. (2017) examples of green products and services from these group are: Green Project Finance, Green Securitization, Green Venture Capital and Private Equity, Technology Leasing, Carbon Finance, and others.

1. (a). **Green Project Finance:** Also known as non-resource finance, are loans offered to fund large infrastructure projects such as telecommunications, petrochemicals (fuel financing), and natural resources (wind portfolio financing). These projects are usually financed under equity contributions of 30-40% and 60-70% through debts.
2. (b). **Green Securitization:** Involve the use of asset-backed securities associated with environmental infrastructure projects where investment banks purchase new bonds at an assured price which is then resold to institutional investors. These forms of security bonds include forest bonds, cat bond, Eco securitization and partial credit guarantees.
3. (c). **Green Venture Capital and Private Equity:** Banks play key role in Green Venture Capital and Private equity through establishment of capital base for climate mitigations projects, supports from capital markets (Initial Public Offers (IPOs) and bond issues) for clean technology providers, Carbon credit developers and other firms marketing environmental products and services.

Green Assets Management

This is one of the fastest emerging sectors in the financial institution, which currently is a core business of some firms. The focus here, is the provision of financial advice and supports to customers on estate planning, mutual funds, pension funds, taxes, trust services, international financial planning, and private banking. Howbeit, Sachs et., al. (2019) argued that for industries to achieve sustainable development goals they must scale up funding green investments. As described by NAFT (2007) reports, examples of green asset management products are:

1. (a). **Fiscal green funds:** By purchasing shares or investing in Dutch Green Funds provide citizen with opportunity of been exempted from paying capital gain tax as well as getting discount on income tax.

2. (b). **Cat Bond Funds:** Developed by Credit Suisse in Europe aimed at funding climate-related natural disasters.
3. (c). **Carbon Funds:** Collaboration of private financial firms and joint development institutions has led to the emergence of financing Green House Gas (GHG) emission reduction projects, by receiving money from investors to purchase Emission Reduction Units (ERUs)/ Certified Emission Reduction (CER) or invest in new climate-friendly opportunities. Major banks in Europe have implemented GHG emission funding, while North America banks are yet to follow suit.

Green Insurance

Generally, insurance institution can be categorised into: Life Insurance and General (Non-Life) insurance. Green Insurance falls under the latter and encapsulate into two products areas: 1) products that give insurance premium differentiation based on environmental features; and 2) products targeted toward clean technologies and emission reduction activities (NAFT, 2007; Noh (2010). As seen in investment funds, insurance is a market where green activities are growing significantly. Examples of current green insurance products are linked to feature such as: association of insurance premium and vehicle usage; coverage for Leadership in Energy a& Environmental Design (LEED) certificate buildings; carbon neutral home/auto insurance; coverage for environmentally disabled Small and Medium Enterprises, renewable/clean energy projects. As highlighted by NAFT (2007); Noh (2010); Clemo (2018), products and services of green insurance include:

1. (a). **Auto insurance:** Involve linking insurance premium with vehicle usage “Pay As You Drive”. Some insurance companies in Europe, North America, Germany and Gerling are currently offering the product. This feature provides clients with additional control, choice, and flexibility over their premium.
2. (b). **Home and business insurance:** Traditional insurance product fail to support special features associated with green building projects which green insurance has gain advantage over. Green building coverage issue certificate of Leadership in Energy & Environmental Design (LEED) to clients. In 2007, the UK Environmental Transport Association (ETA) designed a home insurance product that aimed to offset all emissions from client’s home and vehicle while achieving carbon neutrality (NAFT, 2007).
3. (c). **Coverage for environmentally vulnerable Small and Medium Enterprise:** Small and Medium Enterprises (SMEs) in developed and developing economy have been at risk of non-green practices (Mishra, Choudhury, & Rao, 2019). A study by Clemo (2018), found that close to 70% of SMEs in the United Kingdom are in high-risk area and are presently faced with flooding, with 90% not adequately insured against climate risks. The report also shows that only 8% of these SMEs in flooded areas has received any kind of flood risk warning while only 1 in 4 perceived climate change is a threat to their business. This finding has resulted in the development and growth of green small business insurance products in the UK.

As highlighted by Dash & Das (2012), Evangelinos et., al. (2012), Lymperopoulos et., al. (2012) and Miroshnychenko et., al. (2017), the following are summary of some green marketing activities firms can focus on:

Nexus of Green Management, Green Marketing, Sustainability, and Financial Performance

1. Financing green technology, business, and pollution reducing projects
2. Directing core operations towards making environment eco-friendly.
3. Ensuring substantial economic development and promotion of environmental-friendly practices.
4. Adopting green policy and environmental issues.
5. Engaging in Corporate Social Responsibility (CSR).
6. Concentrate on green marketing, training, and development.
7. Development of green products for customers.
8. Grow mobile and online banking.
9. Promote a cashless environment.
10. Provision of green loan to finance green projects such as creating biogas plant, production of solar energy and many more.

Additionally, Raad (2015) highlighted some features of green banking operations, which can be adopted by any financial services, these are:

1. Helping the environment through adoption of automated and online banking.
2. Focusing on social safety and security through changing the negative impact of the society.
3. Give priority to financing and giving green loan to green investment, and green projects.
4. Caring for sustainable green industry.

From above discussion, a huge need is upon financial services to develop sustainable green marketing strategies to increase their financial performance and the country economy.

IMPACT OF GREEN MANAGEMENT ON FIRMS FINANCIAL PERFORMANCE

The concept of green management is relatively new, and this has made it hard to elucidate comprehensive and appropriate definition and interpretation for it. Peng & Lin (2008); Costello (2008) viewed it as compliance guide to regulatory standard to reducing waste, which in turn contributes to the organization 's goal of making money. While Haden, Oyler, & Humphreys (2009) posit it as a new corporate strategy, organisational reengineering, innovation strategy, social responsibility, or an overall change in business processes with the goal of climate change. Similarly, studies of Florida & Davison (2001); Darnall, Jolley, & Handfield (2008) have addressed the term while focus of the subject has been the used of environmental management and environmental management system (EMS) as a tool for continuous improvement of business performance and the environment performance. Additionally, Darnall, Jolley, & Handfield (2008) have used the term "corporate environmentalism", "environmental management", and "corporate sustainability" to denote green management.

Even though the concept is new, no doubt, it has brought huge impact on business and financial performance. Banerjee (2001) submits that the scope of green management strategies has advances from reactive to proactive, which in turn has created innovative and competitive advantage to firms that utilise it. Likewise, Freeman, Pierce, & Dodd, 2000 argued that green management philosophy in collaboration with financial performance of a firm, will simply ask the question "Does it pays to go green?". Traditionally, climate protection also comes with additional burden and cost on companies as imposed by

government and production. However, the challenge in the past decade has been associating company's environmental performance with better economic and financial performance.

Furthermore, Ambec & Lanoie (2008), systematic review provided empirical evidence of improvement in environmental, economic as well as financial performance of firm and economy. The following channels were stated as potential revenue increase or cost reduction in relation to better environmental practices: (a) better access to certain markets; (b) differentiating products; (c) selling pollution-control technology; (d) risk management and relations with external stakeholders; (e) cost of material, energy, and services; (f) cost of capital; and (g) cost of labor. In addition, meta-analytical review of Endrikat, Guenther and Hoppe (2014) clearly concluded that green management lead to a "win-win" situation for firm, resulting in better environmental and financial performance. Similarly, the empirical findings of Chengli et., al. (2020) revealed that green management foster industry competition, enhances innovative performance as well as attract government supports and strengthens environmental scanning and organizational green management relationships.

CORRELATION BETWEEN SUSTAINABLE ECONOMY AND SUSTAINABLE FINANCIAL SERVICES

The concept of sustainability has been long in existence, Hawken (1993) stated the golden rule by defining sustainability as "leave the world better than you found it, take no more than you need, try not to harm life or the environment, [and] make amends if you do". Ehrenfeld (2008) described sustainability as the possibility of human and other life to have a long lifespan and live forever on planet earth. According to the sustainable-value framework of Hart & Milstein (2003), firms are to create sustainable value by adopting both internal (pollution prevention and clean technology) as well as external (product stewardship and sustainable vision) green practices. Furthermore, Loknath & Azeem (2017) explained the three interdependent dimensions of sustainability, as related to the **environment, economic, and society** – often known as the **triple bottom line. Summarised as follows:** "*Since the publication of Brundtland report by the United Nations, industry practice has embraced the notion that sustainability derives from focusing on the triple bottom line (Slaper & Hall, 2011). The term —Triple Bottom Line (TBL) dates to the mid 1990's, when management think tank Accountability coined and began using the term in its work. The term found public currency with the 1997 publication of the British edition of John Ellington 's Cannibals with Forks: The Triple Bottom Line of 21st Century Business. The TBL approach pioneered by the Institute of Social and Ethical Accountability emphasises that companies are responsible for multiple impacts on society, with associated bottom lines. TBL as it is evolving is a systematic approach to managing the complete set of a company 's responsibilities. At its broadest, the term is used to capture the whole set of values, issues, and processes that companies must address to maximise the positive impacts of their activities and generate added economic, social, and environmental value. At its narrowest, the term is used to refer to a framework for measuring and reporting corporate performance against economic.*

Evidently, many studies from different nations shows that there is a strong relationship between economic growth, and sustainable financial services: Alinska, Filipak & Kosztowniaka (2018) in Poland; Owuigbe (2011) in Nigeria; Feng, Chen & Tang (2018) in China; Zhuang, Gunatilake, Niimi, Khan, Jiang, Hasan, Martin, Bracey, & Huang (2018); Lu et., al. (2018), from Asian banks reviews and study. Which in turn has brought huge benefits such as poverty alleviation, sustainable agricultural activities,

reduction of gas emissions, into the economy. Findings of Saxena & Khandelwal (2010) revealed that today's 21st industries have high concern to protect their environment and concluded that green marketing is a vital tool for sustainable growth and remain competitive. Additionally, in corporate social and responsibility and sustainability, Weber, Diaz & Schwegler (2012) revealed that financial services have a strong impact on sustainable development of an economy. Furthermore, Nugroho, Badawi & Hidayah (2019) opined that sustainable finance is a collaborative support that financial services sector must implement to produce a sustainable economy. This is said to harmonise economic, societal, and environmental stakeholders' goals. Also, Sachs et., al. (2019) emphasized the importance of developing green policy and green financial activities. Therefore, conclusively, development of sustainable services and products in the financial sector is crucial as it positioned this industry toward the sustainable development of the economy.

FUTURE RESEARCH WORK

Limited research has been done in both traditional and green marketing mix and management with focus on financial services. As part of future work, this chapter suggests exploring and developing core green marketing mix strategies for financial services sectors and its impact on the nations economy.

CONCLUSION

Green marketing must be responsive and have environmentally concern goals. Green marketing mix foster company competition and sustainability. Green management include the development of green products and service. To this end, all business sectors must develop and adopt green marketing strategies to gain competitive advantage. Since green marketing strategies addresses many fundamental areas of business such as market segmentation, green product development, green positioning, setting green price, application of green logistics, green, projects, green financing, green loan, green partnership, waste management, green partnership and having green marketing mix.

This chapter highlighted the benefits of green marketing, concept and the vital elements of green marketing mix and the aspect of "go green" in overall business management. A deep insight of the green marketing mix over the conventional marketing mix was explained. Impact of green marketing mix on firms' sustainability was uncovered. Green marketing activities and products for a sustainable financial sector was revealed. The chapter focused on the deep understanding and relationship between green marketing, green marketing strategies and green management in relations to sustainability of financial performance of business in the era of climate change. Therefore, in ensuring a sustainable economy, recommended strategies in this chapter should be well considered and executed to by all stakeholders in the business world.

REFERENCES

- Abigail, A. (2003). Maynard. Reducing Fertilizer Requirements in Cut Flower Production. *BioCycle*, 44(43).
- Adriana, B. (2019). Green Marketing mix: A case study of Brazilian retail enterprises. *J. Environ Qual. Manag.*, 28(3), 111–116. doi:10.1002/tqem.21608
- Akanwa & Joe-Ikechebelu (2019). *The Developing World's Contribution to Global Warming and the Resulting Consequences of Climate Change in These Regions: A Nigerian Case Study*. . doi:10.5772/intechopen.85052
- Al-Salaymeh M (2013). The application of the concept of green marketing in the productive companies from the perspective of workers. *Interdisciplinary Journal of Contemporary Research in Business*, 4(12), 634-641.
- Alińska, A., Filipiak, B. Z., & Kosztowniak, A. (2018). The Importance of the Public Sector in Sustainable Development in Poland. *Sustainability*, 10(9), 3278. doi:10.3390/s10093278
- Ambec, S., & Lanoie, P. (2008). Does It Pay to be Green? A Systematic Overview. *The Academy of Management Perspectives*, 22(4), 45–62. doi:10.5465/amp.2008.35590353
- American Marketing Association Dictionary. (n.d.). http://www.marketingpower.com/_layouts/Dictionary.aspx
- Arseculeratne, D., & Yazdanifard, R. (2014). How Green Marketing Can Create a Sustainable Competitive Advantage for a Business. *International Business Research*, 7(1), 130.
- Aykol, B., & Leonidou, L. C. (2015). Researching the green practices of smaller service firms: A theoretical, methodological, and empirical assessment. *Journal of Small Business Management*, 53(4), 1264–1288. doi:10.1111/jsbm.12118
- Banerjee, S. (2001). Corporate environmental strategies and actions. *Management Decision*, 39(1), 36–44. doi:10.1108/EUM0000000005405
- Belz, F. M., & Peattie, K. (2009). *Sustainability marketing: A global perspective*. Wiley.
- Brady, D. (2007, June 11). Pepsi: Repairing a Poisoned Reputation in India. *Business Week*, 46-54.
- Cornelissen. (2008). Promoting Sustainable Consumer Behaviour by Cueing Common Environmental Behaviours as Environmental. *International Journal of Research in Marketing*, 25(1), 46-55.
- Costello, M. (2008). 13 Steps to Green Your Business. *Business and Economic Review*, 54(4), 6–9.
- Dahlstrom, R. (2010). *Green Marketing Management*. South Western Centage Learning Press.
- Daly, H. (1996). *Beyond Growth*. Beacon Press.
- Darnall, N., Jolley, G., & Handfield, R. (2008). Environmental Management Systems and Green Supply Chain Management: Complements for Sustainability? *Business Strategy and the Environment*, 18(1), 30–45. doi:10.1002/bse.557

- Dash, B. M., & Das, S. M. (2012). Green marketing strategies for sustainable business growth. *Journal of Business Management & Social Sciences Research*, 1, 82–87.
- Dvorakova, Z.L, Cudlinova, E., Partlova, P., & Petr, D. (2016). Importance of Green Marketing and its potential. *Journal of Bioeconomy and Sustainable Development*, 5(2), 61-64.
- Ehrenfeld, J. (2008). *Sustainability by Design*. <http://baudson.cute-ice.de/serendipity/index.php/?/archives/27-Sustainability-by-Design-John-R.-Ehrenfeld,-2008.html>
- Endl, A. (n.d.). *Sustainable investment: options for a contribution to a more sustainable financial sector*. https://www.sdnetwork.eu/pdf/case%20studies/ESDN%20Case%20Study_No.%2011_sustainable%20investment_FINAL.pdf
- Endrikat, J., Guenther, E., & Hoppe, H. (2014). Making sense of conflicting empirical findings: A meta-analytic review of the relationship between corporate environmental and financial performance. *European Management Journal*, 32(5), PP735–PP751. doi:10.1016/j.emj.2013.12.004
- Eneizan, B. M., & Wahab, K. A. (2016). Effects of Green Marketing Strategy on the Financial and Non-Financial Performance of Firms: A Conceptual Paper. *Arabian J Bus Manag Review*, 6, 254.
- Evangelinos, K. I., Skouloudis, A., Nikolaou, I. E., & Filho, W. L. (2009). *An Analysis of Corporate Social Responsibility (CSR) and Sustainability Reporting Assessment in the Greek*. In *Professionals Perspectives of Corporate Social Responsibility*. Springer-Verlag Berlin Heidelberg.
- Feng, Y., Chen, H.H., & Tang, J. (2018). The Impacts of Social Responsibility and Ownership Structure on Sustainable Financial Development of China's Energy Industry. *Sustainability*, 10(2), 301. doi:10.3390/u10020301
- Florida, R., & Davison, D. (2001). Gaining from Green Management: Environmental Management Systems inside and outside the Factory. *California Management Review*, 43(3), 64–84. doi:10.2307/41166089
- Freeman, R., Pierce, J., & Dodd, R. (2000). *Environmentalism and the New Logic of Business*. Oxford University Press.
- Gopalakrishnan, M. S., & Muruganandam, D. A. (2013). Micro analysis on Dissect of Consumer's to Procure Green Products. *Life Science Journal*, 10(2), 1028–1032.
- Haden, S. P., Oyler, J., & Humphreys, J. (2009). Historical, practical, and theoretical perspectives on green management: An exploratory analysis. *Management Decision*, 47(7), 1041–1055. doi:10.1108/00251740910978287
- Hasan, Z., & Ali, N. A. (2015). The impact of green marketing strategy on the firms performance in Malaysia. *Procedia: Social and Behavioral Sciences*, 172, 463–470. doi:10.1016/j.sbspro.2015.01.382
- Hass, J. (1996). Environmental (green) management typologies: An evaluation, operationalization and empirical development. *Business Strategy and the Environment*, 5(2), 59–68. doi:10.1002/(SICI)1099-0836(199606)5:2<59::AID-BSE49>3.0.CO;2-W
- Hawken, P. (1993). *The Ecology of Commerce: A Declaration of Sustainability*. Collins Business.
- Jin. (2010). *Financial Strategy to Accelerate Innovation for Green Growth*. Korea Capital Market Institute.

- Kärnä, J., Hansen, E., & Juslin, H. (2003). Social responsibility in environmental marketing planning. *European Journal of Marketing*, 37(5/6), 848–871. doi:10.1108/03090560310465170
- Kent, T., & Stone, D. (2007). The Body Shop and the Role of Design in Retail Branding. *International Journal of Retail & Distribution Management*, 35(7), 531–543. doi:10.1108/09590550710755912
- Khan, E. A., Royhan, P., Rahman, M. A., Rahman, M. M., & Mostafa, A. (2019). The Impact of Enviropreneurial Orientation on Small Firms' Business Performance: The Mediation of Green Marketing Mix and Eco-Labeling Strategies. *Sustainability, MDPI, Open Access Journal*, 12(1), 1–17. doi:10.3390u12010221
- Kim, C. (2008). Preparing for Climate Change: Insurance and Small Business. In *The Geneva Papers on Risk and Insurance* (Vol. 33, No. 1, pp. 110-116). Palgrave Macmillan. <https://www.jstor.org/stable/41952976>
- Lalon, R. M. (2015). Green Banking: Going Green. *International Journal of Economics, Finance and Management Sciences.*, 3(1), 34–42.
- Larashati, H., Hudrasyah, H., & Chandra, N. (2012). *7Ps of green marketing as factors influencing willingness to buy towards environmentally friendly beauty products*. Academic Press.
- Leonidou, C. N., Katsikeas, C. S., & Morgan, N. A. (2013). “Greening” the marketing mix: Do firms do it and does it pay off? *Journal of the Academy of Marketing Science*, 41(2), 151–170. doi:10.100711747-012-0317-2
- Lu, W. Ye. M., Chau, K. W., & Flanagan, R. (2018). The paradoxical nexus between corporate social responsibility and sustainable financial performance: Evidence from the international construction business. *Corporate Social Responsibility and Environmental Management*, 25(5), 844–852. doi:10.1002/csr.1501
- Lymperopoulos, I. E., Chaniotakis, I. E., & Soureli, M. (2012). A model of green bank marketing. *Journal of Financial Services Marketing*, 17(2), 177–186. doi:10.1057/fsm.2012.10
- Manjunath, G., & Manjunath, G. (2013). Green Marketing and its Implementation in Indian Business Organizations. *Asia Pacific Journal of Marketing & Management Review*, 2(7), 75–86.
- McIlvaine, B. (2007). By products can Make Coal Plants Green. *Power Engineering*, 38(42).
- Millat, K. M., Chowdhury, R., & Singha, E. A. (2012). *Green Banking in Bangladesh: Fostering Environmentally Sustainable Inclusive Growth Process*. Bangladesh Bank. <http://www.bangladesh-bank.org/pub/special/greenbankingbd.pdf>
- Miroshnychenko, Barontini, & Testa. (2017). *Green practices and financial performance: A global outlook*. Academic Press.
- Mishra, M. K., Choudhury, D., & Rao, V. G. (2019). Impact of Strategic and Tactical Green Marketing Orientation on SMEs Performance. *Theoretical Economics Letters*, 9(5), 1633–1650. doi:10.4236/tel.2019.95104
- Molina-Azorín, J. F., Claver-Cortés, E., López-Gamero, M. D., & Tarí, J. J. (2009). Green management and financial performance: A literature review. *Management Decision*, 47(7), 1080–1100. doi:10.1108/00251740910978313

Noh, H. J. (2010). *Strategies of Developing Green Finance*. Seoul: Korea Capital Market Institute (KCMI). <https://www.adb.org/sites/default/files/publication/452656/adbi-wp866.pdf>

OECD. (2009). *Sustainable manufacturing and eco-innovation: towards a green economy*. Policy Brief. OECD.

Ottman, J. (2011). *The new rules of green marketing: Strategies, tools, and inspiration for sustainable branding*. Berrett-Koehler Publishers.

Papadas, K.-K., Avlonitis, G. J., Carrigan, M., & Piha, L. (2019). The interplay of strategic and internal green marketing orientation on competitive advantage. *Journal of Business Research*, 104, 632–643. doi:10.1016/j.jbusres.2018.07.009

Peng, Y., & Lin, S. (2008). Local Responsiveness Pressure, Subsidiary Resources, Green Management Adoption, and Subsidiaries' Performance: Evidence from Taiwanese Manufacturers. *Journal of Business Ethics*, 79(1/2), 199–212. doi:10.1007/10551-007-9382-8

Procter & Gamble. (n.d.). <http://www.pg.com>

Ragnhild, B. Fuglestedt, Berntsen, Peters, Andrew, Allen, & Kallbekken. (2017). Perspective has a strong effect on the calculation of historical contributions to global warming. *Environ. Res.*, 12(2).

Rahman, M. M., Ahsan, M. A., Hossain, M., & Hoq, M. R. (2013). Green Banking Prospects in Bangladesh. *Asian Business Review*, 2(4). doi:10.18034/abr.v2i2.112

Ranjan, R. K. (2020). Green Marketing: An Exploration through Qualitative Research. *Global Journal of Management and Business Research*, 19(8), 27–35.

Sachs Jeffrey, D., Woo, W. T., Yoshino, N., & Taghizadeh-Hesary, F. (Eds.). (2019). *Handbook of Green Finance: Energy Security and Sustainable Development*. Tokyo: Springer.

Saxena, R., & Khandelwal, P. K. (2010). *Sustainable development through green marketing: The industry perspective 2010*. Academic Press.

Shu, C., Zhao, M., Liu, J., & Lindsay, W. (2020). Why firms go green and how green impacts financial and innovation performance differently: An awareness-motivation-capability perspective. *Asia Pacific Journal of Management*, 37(3), 795–821. doi:10.1007/10490-018-9630-8

Slaper, T., & Hall, T. (2011). The Triple Bottom Line: What Is It and How Does it Work? *Indiana Business Review*, 1-7.

Slobodan & Peter. (2012). Green Banking -Green Financial Products with Special Emphasis on Retail Banking Products. In *2nd Climate Change, Economic Development, Environmental and People Conference (CCEDEP)*. Sremska Kamenica: Educons University.

Thaker, J., Smith, N., & Leiserowitz, A. (2020). Global Warming Risk Perceptions in India. *Journal of Risk Analysis*, 40(12), 2481-2497.

Tiwari, S., Tripathi, D. M., Srivastava, U., & Yadav, P. K. (2011). Green Marketing -Emerging dimension. *Journal of Business Excellence.*, 2(1), PP-18–PP-23.

Nexus of Green Management, Green Marketing, Sustainability, and Financial Performance

UNEP Finance Initiative. (2007). *Green Financial Products and Services Current Trends and Future Opportunities in North America*. A report of the North American Task Force (NATF) of the United Nations Environment Programme Finance Initiative. https://www.unepfi.org/fileadmin/documents/greenprods_01.pdf

Uwugbe, O. R. (2011). An Empirical Investigation of the Association between Firms' Characteristics and Corporate Social Disclosures in the Nigerian Financial Sector. *Journal of Sustainable Development in Africa*, 13(1). 60-74.

Vincent, I. (2020). *Implication of green marketing for a developing economy*. Department of Economics & Management Science, Nigeria Police Academy.

Westpac. (2006). *Stakeholder Impact Report*. www.westpac.com.au

Zhang, X., Shen, L., & Wu, Y. (2011). Green strategy for gaining competitive advantage in housing development: A China study. *Journal of Cleaner Production*, 19(2-3), 157–167. doi:10.1016/j.jclepro.2010.08.005

Zhuang, J., Gunatilake, H. M., Niimi, Y., Khan, M. E., Jiang, Y., Hasan, R., Khor, N., Martin, A. L., Bracey, P., & Huang, B. (n.d.). *Financial Sector Development, Economic Growth, and Poverty Reduction: A Literature Review*. Asian Development Bank Economics Working Paper Series No. 173. doi:10.2139/ssrn.1617022

Chapter 22

Roles of Accountants in Climate Change Mitigation, Adaptation, and Resilience

Odunayo Magret Olarewaju

 <https://orcid.org/0000-0002-4366-040X>

Durban University of Technology, South Africa

ABSTRACT

Accountants are in a better position to contribute to initiatives that lead to low-carbon business models that promote economic sustainability by defining climate risk and analysing the strategic, organisational, and financial consequences of the risk mitigation and adaptation. Extensive review and assessment of the roles of accountants in climate change mitigation, adaptation, and resilience was done in this chapter. The chapter concluded by recommending inclusion of a climate change fund in integrated reporting of organisations and intensification of climate change awareness such that every organisation will be aware of how proper accounting can be done on climate change effects. Thereafter, strategies to mitigate, adapt, and be resilient towards it will be initiated.

INTRODUCTION

Climate change remains a central topic as well as major concern on national and foreign policy agendas (Bodansky, Brunnée & Rajamani, 2017; Afionis, 2017; Nordhaus, 2020; Luomi, 2021). Clearly, climate change continues to pose significant business complications that subsequently affect financial performance of businesses (Geels, 2013; Manokaran, Ramakrishnan, Hishan & Soehod, 2018). A complex impact on the environment will have substantial implications for society and businesses if not managed efficiently and effectively (Dafermos, Nikolaidi & Galanis, 2018). Therefore, accountants have an essential responsibility in maintaining clarity regarding threats and opportunities related to the environment (O'Dwyer & Unerman, 2020). A gradual and just transformation to a net zero emissions economy will encourage better transparency as well as better disclosure. Accountants play an essential role in helping businesses respond to climate change. Accountants have an important opportunity to take a leading

DOI: 10.4018/978-1-7998-7967-1.ch022

role in the creation and implementation of long-term business strategies to mitigate and acclimatize to climate change. In understanding the “new language” of climate change that has arisen in the accounting profession, the 2019 Chartered Institute of Management report is noteworthy. The value of working ‘alongside professional experts’ is demonstrated by the strong role of financial accountants, with their experience and knowledge in developing technical practices to adapt to climate change. In acknowledgment of the issue of climate change and its consequences, there has been a rapid rate of change and an apparent effort by the accounting profession to “catch up.” As these studies show, a variety of accounting specialist organizations see an opportunity for accountants to play a leadership role in climate change.

The purpose of this book chapter is to provide a general insight into the importance of issues at hand, given that minimal research has been done on the same subject. It will also contribute to the problem as a new understanding of the role of climate change accountants in the survival and viability of companies around the world. In addition, it will be necessary to improve the awareness of business leaders, policy makers, shareholders, etc. This study therefore intended to address the above-mentioned discrepancies by presenting information on the role of accountants in the mitigation, adaptation and resilience of climate change by examining the undisturbed gap and replicating the current gap in businesses. Recommendations on how business can be responsive to climate change will be given towards the end of this book chapter.

OVERVIEW OF RESPONSE OF ACCOUNTING PROFESSION TO CLIMATE CHANGE

As one of the sustainable development goals is on climate actions, dwindling climates undoubtedly have a huge impact on nature, sectors and the general society, financial sectors inclusive. Climate change is a systemic risk that has huge impact on the finance industry, as like other sectors of the global economy (WWF, 2005). According to Srikant and Teekchandani (2020), climate change has many impacts on businesses. Climate change is a major problem generating both risks and opportunities that will have a direct impact on the economy and the financial sector.

The Association of International Certified Professional Accountants (AICPA) endorsed a call for change in response to environmental changes, together with the chief executive officers (CEOs) of 12 other accountancy bodies, given the seriousness of the climate danger and the potential for the accounting profession to take a leading responsibility. A total of 2.5 million accountants were collectively identified in 179 countries as part of the Prince of Wales Accounting for Sustainability Initiative Accounting Bodies Network. This sense of urgency is not only for accountants, but for the professional accountants that serve them. It is a responsibility for the profession to endorse the essential work members do through funding, advice and advocacy work with policymakers to mitigate climate risk.

The profession would have an impact in at least two main ways: by fostering strategic planning and by ensuring accurate, objective disclosure of knowledge relevant to sustainability. In this dynamic, interdependent environment, integrated thinking about the number of financial and non-financial factors that significantly impact the ability of an entity to generate value is needed. The profession, responsible for controlling the flow of critical knowledge and perspective, is ideally positioned to advance a more holistic view of challenges and opportunities, including the identification and planning of climate-related risks such as interrupted supply chains and changes in regulations (Wasim, 2019).

Accountants will allow for better judgment through integrated thought. Reliable knowledge is the underpinning of all sound decision, whether by business leaders, regulators, investors or customers.

Together, the skill set and experience of the profession make leadership and public accountants highly suited to calculate, report and provide assurance of reliable, comparable and substantive information relevant to sustainability.

ROLE OF ACCOUNTANTS IN ENVIRONMENTAL SUSTAINABILITY

In recognition of important environmental and social concerns that concurrently offer opportunities, the demands put on management accountants have increased (Sands, Lee, Schaltegger & Zvezdov, 2015). Such demands require a rich supply of data, capable of educating people about the consequences of their choices and allowing them to act. Developing new accounting methods and analysis is one approach to the task of providing such knowledge (Clarke & O'Neill, 2005). As part of corporate sustainability reporting, accountants play a crucial role in evaluating and exposing climate risks and are becoming active players in the company climate management (Sands et al., 2015; Bebbington, Russell & Thomson, 2017). Climate change is an integral part of the evolving risk management system, and finance professionals are being asked to go beyond a technical understanding of the problem (Bebbington, Russell & Thomson, 2017). Sustainability methods used to be all about the bottom line, but accountants are in the strongest position to make a difference by cultivating themselves on sustainability issues as a result of these changes. In such well-organized activities, the management accountant may be a valuable facilitator and collaborator. While integration is beginning to take place at the strategic and organizational levels, reporting is still not integrated (Clarke & O'Neill, 2005).

Some corporations produce an annual report with detailed financial information and an add-on impact on society and the environment (Hummel, Schlick & Fifka, 2019). Condemnation of such reporting has been that only good coverage is reported by businesses and add-on stories tend to legitimise behaviour where the society is affected by them. The criticism would dissipate if the outcomes were actually representative of attempts to integrate sustainable policies into an organisation's activities. Environmental accounting is the field of study that deals with the utilisation of capital and communicates and calculates the cost of the national economic or environmental effects of businesses (Deegan, 2013). The expenses include the costs of cleaning up or restoring clean contaminated areas, environmental fines and taxes, the procurement of pollution control methods and the expense of waste management.

Two forms of accounting are used in the environmental accounting scheme, the first being environmentally-based traditional accounting as well as the second being ecological accounting. These assess the effects of the natural environment on a business in financial terms in environmentally distinct accounting, while environmental accounting measures the environmental effect on the company, but according to direct characteristics. The organisation's development and sustainability depend on operational efficiency and profitability, but it is not enough for a company to meet the continuous growth objective, so the responsibility of the enterprise is no longer seen as just economic performance, as environmental and social responsibility is required to be taken into account by the organisation.

ROLE OF ACCOUNTANTS IN MITIGATING CLIMATE CHANGE

As the consequences of climate change intensify, addressing climate as a structural risk suggests that changes in the system must be affected by climate policy. Therefore, carbon pricing schemes are a

Roles of Accountants in Climate Change Mitigation, Adaptation, and Resilience

requirement (though not a panacea) as cost inevitably affects behaviour and choices. Carbon pricing specifically facilitates investment in advanced low-carbon technology that will reduce emissions more rapidly. Economic experts and business leaders accept this and, through the Climate Leadership Board, are calling for carbon pricing, which supports a carbon dividend scheme that will reduce the US carbon dioxide footprint by half (Duarte, Losada, Hendriks, Mazarrasa & Marbà, 2013).

As British Columbia has demonstrated, the implementation of a carbon tax has helped reduce emissions without adversely affecting the rate of growth. Sadly, much of the momentum on climate change action so far has been baby steps. As was clearly demonstrated at the World Economic Forum, there is a significant function that audit geeks as well as accountants play. The World Economic Forum agreed that corporations that do not counter the prospect of carbon taxes and higher carbon prices would be costly to the bottom-line, and that a global carbon tax is expected to cost firms and their reputations \$4 trillion. It is time for accountants to help shift the needle more substantially and internationally.

The International Federation of Accountants (IFAC), as the global voice of the accounting profession, advocates market-based policies and legislative measures that lead to low-carbon business models and more comprehensive, reliable, and equivalent climate risk disclosures. In their Rallying call in tackling climate change, the business leaders of the Prince of Wales Accounting for Sustainability (A4S) initiative stressed the need for market-based supportive policies and greater accountability.

Governments should not be content with progressive changes in reporting and accountability alone as climate change becomes a more urgent political priority. This is when it comes to market-based policy. It means that its impacts are paid for by those who are most concerned about climate change. Either by a carbon tax or emissions trading scheme (ETS), carbon pricing allows companies the freedom to choose their own reaction and adoption policies while explicitly representing the social cost of carbon dioxide (CO₂) emissions in the financial statements of a company. Action to curb pollution and reduce demand for carbon-intensive goods and services is likely to be motivated by these strong financial implications.

These costs will be handled by a company as all other running costs and aimed at minimising them. Inside their activities and investments, a growing number of businesses are now implementing internal carbon pricing to facilitate change. For example, Microsoft uses internal carbon pricing to push its renewable energy production and improve energy efficiency in the midst of extreme criticism directed at the entire technology industry for failing to measure its climate footprint. It is important to strengthen reporting on climate risk and its financial consequences and to move towards new models. For accountants, now is a crucial time to not only plan for imminent carbon pricing and to get ahead of it.

Accountants will ensure that their companies are prepared for the future in their positions as chief financial officers (CFOs) and finance experts by helping to make decisions that factor in possible carbon prices and the upcoming rise in climate-related legislation. This involves the use of internal pricing to inform capital investment decisions and to help determine opportunities and risks and how adaptation might be required for strategies and plans. Accountants are in a better position to contribute to initiatives that lead to low-carbon business models that promote economic sustainability by defining climate risk and analysing the strategic, organisational and financial consequences. If a discipline fails to recognise these shifts and motivate them, it can swamp their activities. Businesses need to retort to the climate emergency; they need to consider in the rear view rather than down the lane. The time has come for accountants to take the driver's bench.

ROLE OF ACCOUNTANTS IN CLIMATE CHANGE ADAPTATION

According to Linnenluecke, Birt and Griffiths (2015), in tackling climate change, companies of all kinds and sizes have two main options: mitigation and adaptation. In allowing the customer to respond to climate change, accounting professionals play an integral role. Global warming is a fact, regardless of opinions about the causes. Analysis shows that environmental and business practices are influenced by global warming. Global warming doubters have too many arguments. They claim that there is no consensus among scientists on the nature and impacts of climate change, that in 1998 global warming ceased, or that the increasing temperature of the planet is due to the sun, not human carbon dioxide emissions. A research analysis that may not go down too well with these climate change skeptics is a survey of accounting professionals who can see the effect of global warming first-hand. In 2016, the Institute of Management Accountants performed a study of senior management accountants and discovered that a number of respondents agree that global warming occurs, 65 percent trust that global warming has a severe influence on climate change, while 62 percent said it had a considerable effect on the business with the increasing cost of inputs identified as one of the utmost common penalties.

The accounting profession has made strides in the area of sustainability reporting and integrated reporting in recent years. The International Integrated Reporting Council system is being implemented by key exchanges in the world, reinforcing their criteria for listed companies to divulge their environmental, corporate governance compulsions, such as the Hong Kong Stock Exchange and about 1,500 big firms around the world.

As management accountants have introduced balanced scorecards that include both economic and non-financial success indicators, many businesses are now evaluating the environmental impact and other sustainability metrics. However, for the scorecard of a corporation, these will be suitable non-financial steps. The adds that businesses are now devoting in renewable energy investing in carbon emission reduction technologies. In order to make suitable investment decisions, accountants are critical. Today, those who are worried about the planet's future are mostly younger accountants.

Internal control as well as accountants cannot save the planet as long as they are used to account for companies whose only legal obligation is to maximize profits. Modern company, which emerged from the industrialization of the United States and the United Kingdom in the nineteenth century, requires legal reform in order to broaden its obligations beyond its dependence on financial capital. Global warming has a major environmental effect and should therefore be discussed. Also, companies should participate in activities that support environmental sustainability to the degree that the social, economic and environmental priorities of their companies are properly balanced.

Instead of focusing on being more eco-friendly or shifting to clean energy sources, or companies shifting their assembly facilities, many heads of finance understand that environmental concerns can be in the lead to disruptions in the supply chain. When making purchase decisions, environmental sustainability is rapidly becoming a primary criterion for companies and customers in two ways, environmental concerns impact businesses. First of all, it is the cost-saving side, combined with the use of energy-saving lamps and by the internal introduction of green initiatives by encouraging workers to print carefully and reduce energy use. Second, it actually provides more resources for the industry. Risk management skills gained by Certified Professional Accountants are crucial in addressing this issue. They can at the very least mitigate the risk by order to hedge malt prices, for example. Accountants should offer more attention to capital expenditure in terms of environmental criteria from local authorities in order to help the environment while avoiding penalty fees by collecting capital expenditure to spend over the year.

RESPONSE OF ACCOUNTANTS TO CLIMATE CHANGE CHALLENGES

A latest study revealed minimal integration between risk management and sustainability as well as the Climate Disclosure Standards Board (CDSB), which culminated that the responsibility of sustainability departments under the guise of a Corporate Social Responsibility CSR initiative, highlighting the challenge of making climate change a mainstream disclosure issue. The prime focus of the Task force on climate-related financial Disclosure (TCFD) falls squarely within the mandate of the accountant: to define the magnitude of the financial danger that climate change presents to the financial services sector (Bui & De Villiers, 2017).

These financial risks (including possibilities) must be extracted from an appreciation of the effect of financial services on sustainability as well as the risks associated with them. These largely lie beyond the direct control of customers/investors by the bank/insurer/investor and interpreting them poses unique challenges due to substantial uncertainties and time frames longer than those typically used in business planning. This is likely to lead to evaluations and eventual disclosures that are highly dependent on professional judgment.

Makarenko and Plastun (2017) noted that chartered accountants are therefore very well placed, with their long-established reputation in this respect, to play a crucial role in working across organisations and applying critical thinking to the disclosure of statistics, models, interconnections as well as assumptions. Moreover, the scenario analysis approach on which much of TCFD is focused was certainly capable of being applied more broadly than climate change to the scope of environmental social issues outlined by the Sustainable Development Goals (SDGs). There are also opportunities for companies to create innovative goods and services that help the transformation to sustainability, but these activities may also entail sufficient review, such as in terms of the implementation of plans and budgetary implications. The professional body of accountants has recognised that they are certainly facing significant challenges in terms of the response to climate change as society and the required critical review challenge is more important than ever. Maybe this is the willingness to look through industries and functions that play the major role for public and private accountants, not only minimising the reinvention of the wheel, but also ensuring that appropriate choices are taken between new convergence strategies in conventional management and publishing.

THE USE OF EXPERIENCE AND EXPERTISE BY ACCOUNTANTS TO EVOLVE AND ADAPT TO CLIMATE CHANGE MITIGATION PROCESSES

According to companies and climate change specialists in the recent ACCA (Association of Chartered Certified Accountants) report, COP17, the latest step in international attempts to reduce human effects on the environment, accountants have the technological skills and experience to make a meaningful impact in mitigating climate change activities. It is also necessary for accountants to be part of combating climate change. When it comes to influencing international climate change mitigation strategies, accountants ought to take a leadership role (Thomas, Hardy, Lazrus, Mendez, Orlove, Rivera-Collazo & Winthrop, 2019). The profession has considerable expertise in the processes of assessment, monitoring and validation, all of which will be crucial for any credible climate change action. To contribute positively to the formulation of effective policy interventions and agreements, the profession needs to use its skills. ACCA's new COP17 report details the recently launched perception by experts on the

position of climate change accountant professionals, including Vodafone, Shell, HSBC, Deloitte, and PwC, and international climate change negotiators. These experts agreed that accountants play a key role in attempts to reduce or control emissions that lead to climate change.

Their jobs, however, required the creation of new expertise and methods to meet new requirements and they reworked their prospectuses and skills to provide the faith and trust required in the skills and integrity of the occupation. Regrettably, lack of credible way to check the emission reductions inhibits confidence-building in climate change mitigation which can discourage key private sector investment. The profession is committed, and in the past the profession has been flexible and able to face this new challenge. It's a job where sustainability accounting is needed. Deloitte and PwC experts argue that the private as well as finance sectors have a significant role to play in combating climate change. They are innovative and instrumental but are not currently used or properly funded by the UNFCCC (UN Framework Convention for Climate Change).

There are small expectations of COP17, but negotiations can also lead to small steps to achieve a potentially more substantive agreement. Voluntary emission targets are essential without a binding international agreement, but legitimacy is not assured until uncoordinated steps are adequate to avoid catastrophic global warming. The failure to comply with potential commitments of non-Accord countries has led to a diplomatic stand-off that prevents any new international emissions-reducing deal. The battle against climate change must be a joint effort and there will be a part for accountants, countries, private enterprises and finance to play. To ensure that their interests, insights and ideas are shared, private business and finance need to speak up, while the UNFCCC mechanism needs to bring private enterprise into the process if it is to achieve the targets it has set itself.

FACTORS INFLUENCING CLIMATE CHANGE MITIGATION AND ADAPTATION

Climate change is causing social and environmental problems (Pihkala, 2018). Typical climatic conditions and the severity and intensity of climatic events have already been influenced by growing greenhouse gas (GHG) emissions (Touma, Stevenson, Lehner & Coats, 2021). The effects of climate change on social structures are projected to be substantial, especially in developing nations where populations are at greatest peril and have the least potential for change (Cramer, Guiot, Fader, Garrabou, Gattuso, Iglesias & Xoplaki, 2018). As a result, policy makers have to promote GHG emission reductions and facilitate adaptation to mitigate climate change vulnerabilities. The strides taken to lessen and alleviate GHG emissions are mitigation measures, while adaptation measures are attentive on reducing susceptibility to the impressions of climate change (Johnsson, Kjörstad & Rootzén, 2019). Thus, mitigation concentrate on the roots of climate change, while adaptation concentrate on its consequences. Traditionally, study, design and adoption of mitigation procedures over adaptation strategies have been emphasized by the Scientifics along with policy makers (Mi, Guan, Liu, Liu, Viguié, Fromer & Wang, 2019). There has been a move toward a more balanced approach between adaptation and mitigation strategies in climate change science. A number of methods are required to minimize and manage risks, given numerous confronts at differing spatial combined with temporal scales. Therefore, in order to promote the completion of climate-resilient sustainable development initiatives, an appreciation of the factors affecting adaptation and mitigation measures has been acknowledged as a prominent component of research on climate change (Steg, 2018).

A mitigation is defined as limiting temperature based GHG flows into the atmosphere by reducing or expands sources of these gasses or containers, such as oceans, forests and soil, which collect and store these GHGs (Johnsson & Rootzén 2019). The goal is to prevent significant human involvement in the climate system and “stabilize the level of GHGs in a reasonable time frame so that habitats can naturally respond to climate change, to ensure that food security is not disturbed and to enable sustainable growth,” as noted in the Climate Change Mitigation report 2014. Adaptation involves adjustment in a changing world, where adaptation is necessary to the present or planned future environment (Zamasiya, Nyikahadzoi & Mukamuri, 2017). The goal is to reduce our susceptibility to damaging climate change effects (like sea-level encroachment, more intense extreme weather events or food insecurity). It also means maximizing the benefits of climate change (e.g. longer growing seasons or increased yields in some regions).

Society and ethnicities have incorporated and managed climate and extreme changes with various degrees of success (Ali & Erenstein, 2017). The following factors influence climate change adaptation and mitigation:

Environmental Concerns: A greater desire to move toward climate change is correlated with pro-environmental behaviours (Chen, 2020). In the summer, people with greater awareness of the climate use less air conditioning and less heating in the winter than individuals with poor awareness of the environment. Likewise, Nauges and Wheeler (2017) indicated that environmental issues among pro-environmentally driven households resulted in decreased use of water and electricity. It has also been found that environmental awareness is positively linked to buying actions, such as willing to spend for green goods and support for public policies supporting mitigation strategies (Chen, 2020; Xu & Han, 2019).

Climate Change Awareness: Although there is general public understanding and recognition of climate change, most people think its consequences will only happen in the future. This creates a disconnect between the perceived future effects of climate change and contemporary daily lives (Hussain, Liu, Yousaf, Ahmed, Uzma, Ali & Butt, 2018). Strengthening knowledge of the reasons behind climate change will also increase knowledge of the similarities between actions and climate change, and thus support for action on climate change. Ricart, Olcina and Rico (2019) revealed that farmers who felt that climate change was due to human activity were more likely to advocate action on climate change.

Perceived Risk: Individuals who understand how climate change can impact their families are more capable of combating the issue and fighting for climate policies. Smith and Mayer (2018), for example, showed that participants were likely to support climate policy if they believed that climate change posed a threat to their country. Climate change, on the other hand, is not universally regarded as a serious threat. People in developing countries, for example, often perceive climate change as posing a bigger danger to themselves because their communities than people in developed countries.

Perceived Knowledge: People can be influenced by knowledge and awareness in a variety of ways, including their concerns, desire to act, and acceptance of climate policies. Shi et al. (2015) discovered that execution understanding was positively correlated with the ability to change actions. Abrahamse et al. (2007) discovered that households saved energy after being given personalized information about their energy use. This suggests that climate change awareness and understanding may be a key factor in encouraging action, and that people who do not engage in climate change action may be doing so because they lack adequate details.

Financial Self-Efficacy: A significant correlation between self-efficacy and ability to tackle climate change has been shown in many studies (Burnham & Ma, 2017; Pakmehr, Yazdanpanah & Baradaran, 2020). Ung et al. (2015) and Bandura (1982) observed that both instantaneous and responsive adaptation

to natural catastrophes is correlated with greater perceived self-efficacy. Self-efficacy often refers to the sense of financial management, relating to the supposed desire to fulfill a financial objective (Lown, 2011; Mindra, Moya, Zuze & Kodongo, 2017). It can therefore be predicted that, as the financial self-efficacy of households rises, their confidence in the implementation of climate change-related initiatives, considering their objective degree of financial capital, will increase.

Social Capital: In social networks largely composed of relationships between parents, acquaintances, neighbors and others, individuals and households are immersed. Social capital has played an increasingly important role in the literature on climate change because, in addition to promoting collective action among households, these social relations provide support, information and protection (Arunrat, Wang, Pumijumngong, Sereenonchai & Cai, 2017). After and during natural disasters, reliance on family and local networks is important as they can promote speedy turnaround by facilitating knowledge and sharing resources (Pelling & High, 2005).

CONCLUSION

Climate change remains an existential threat to the universe the impact of which is felt on both living and non-living things. For organisations to thrive, accountants should learn to adapt, mitigate and be resilient such that their activities can persist unthwarted. Therefore, it is recommended that a climate change mitigation fund should be incorporated in the integrated reports of an organisation. Undoubtedly, this will play a unique role in spinning countries' climate motivations into climate change action and trailing execution of the set goals. Also, organisations will have proper climate change accounting and there will be proper recording of how climate change has been mitigated by the available resources. Also, accounting researchers are encouraged to concentrate on climate change mitigation, adaptation and resilience in their research as their findings will greatly assist organisations if implemented. Finally, as there is no organisation without an accounting section, climate change awareness should be intensified by accountants in each organisation such that a day can be set aside to create awareness and use this opportunity to sensitise people on the ways to mitigate and build resilience towards the impact of climate change.

REFERENCES

- Afionis, S. (2017). *The European Union in international climate change negotiations*. Taylor & Francis. doi:10.4324/9781315773469
- Ali, A., & Erenstein, O. (2017). Assessing farmer use of climate change adaptation practices and impacts on food security and poverty in Pakistan. *Climate Risk Management*, 16, 183–194. doi:10.1016/j.crm.2016.12.001
- Anderson, C. L. (2018). Climate Change and Infrastructure. *Hous. J. Health L. & Pol'y*, 18, 1. PMID:31097909

Roles of Accountants in Climate Change Mitigation, Adaptation, and Resilience

- Arunrat, N., Wang, C., Pumijumnong, N., Sereenonchai, S., & Cai, W. (2017). Farmers' intention and decision to adapt to climate change: A case study in the Yom and Nan basins, Phichit province of Thailand. *Journal of Cleaner Production*, *143*, 672–685. doi:10.1016/j.jclepro.2016.12.058
- Bandura, A. (1982). Self-efficacy mechanism in human agency. *The American Psychologist*, *37*(2), 122–147. doi:10.1037/0003-066X.37.2.122
- Bebbington, J., Russell, S., & Thomson, I. (2017). Accounting and sustainable development: Reflections and propositions. *Critical Perspectives on Accounting*, *48*, 21–34. doi:10.1016/j.cpa.2017.06.002
- Bodansky, D., Brunnée, J., & Rajamani, L. (2017). *International climate change law*. Oxford University Press.
- Bui, B., & De Villiers, C. (2017). Business strategies and management accounting in response to climate change risk exposure and regulatory uncertainty. *The British Accounting Review*, *49*(1), 4–24. doi:10.1016/j.bar.2016.10.006
- Burnham, M., & Ma, Z. (2017). Climate change adaptation: Factors influencing Chinese smallholder farmers' perceived self-efficacy and adaptation intent. *Regional Environmental Change*, *17*(1), 171–186. doi:10.1007/10113-016-0975-6
- Camacho, A. E., Kelly, M. L., Marantz, N. J., & Weil, G. (2019). Mitigating Climate Change Through Transportation and Land Use Policy. *Envtl. L. Rep. News & Analysis*, *49*, 10473.
- Carney, M. (2015). *Breaking the Tragedy of the Horizon—climate change and financial stability*. Speech given at Lloyd's of London.
- Chen, M. F. (2020). Effects of psychological distance perception and psychological factors on pro-environmental behaviors in Taiwan: Application of construal level theory. *International Sociology*, *35*(1), 70–89. doi:10.1177/0268580919881870
- Chen, S., & Gong, B. (2021). Response and adaptation of agriculture to climate change: Evidence from China. *Journal of Development Economics*, *148*, 102557. doi:10.1016/j.jdeveco.2020.102557
- Chester, M. V., Underwood, B. S., & Samaras, C. (2020). Keeping infrastructure reliable under climate uncertainty. *Nature Climate Change*, 1–3.
- Chinowsky, P. S., Schweikert, A. E., Strzepek, N. L., & Strzepek, K. (2015). Infrastructure and climate change: A study of impacts and adaptations in Malawi, Mozambique, and Zambia. *Climatic Change*, *130*(1), 49–62. doi:10.1007/10584-014-1219-8
- Clarke, K. & O'Neill, S. (2005). Is the environmental professional... an accountant? *Greener Management International*, (49).
- Cramer, W., Guiot, J., Fader, M., Garrabou, J., Gattuso, J. P., Iglesias, A., Lange, M. A., Lionello, P., Llasat, M. C., Paz, S., Peñuelas, J., Snoussi, M., Toreti, A., Tsimplis, M. N., & Xoplaki, E. (2018). Climate change and interconnected risks to sustainable development in the Mediterranean. *Nature Climate Change*, *8*(11), 972–980. doi:10.1038/41558-018-0299-2

- Dafermos, Y., Nikolaidi, M., & Galanis, G. (2018). Climate change, financial stability and monetary policy. *Ecological Economics*, *152*, 219–234. doi:10.1016/j.ecolecon.2018.05.011
- Dietz, S., Bowen, A., Dixon, C., & Gradwell, P. (2016). ‘Climate value at risk’ of global financial assets. *Nature Climate Change*, *6*(7), 676–679. doi:10.1038/nclimate2972
- Duarte, C. M., Losada, I. J., Hendriks, I. E., Mazarrasa, I., & Marbà, N. (2013). The role of coastal plant communities for climate change mitigation and adaptation. *Nature Climate Change*, *3*(11), 961–968. doi:10.1038/nclimate1970
- Fagariba, C. J., Song, S., & Baoro, S. K. G. S. (2018). Climate change in Upper East Region of Ghana; challenges existing in farming practices and new mitigation policies. *Open Agriculture*, *3*(1), 524–536. doi:10.1515/opag-2018-0057
- Geels, F. W. (2013). The impact of the financial–economic crisis on sustainability transitions: Financial investment, governance and public discourse. *Environmental Innovation and Societal Transitions*, *6*, 67–95. doi:10.1016/j.eist.2012.11.004
- Gibassier, D., & Alcouffe, S. (2018). Environmental management accounting: The missing link to sustainability? *Social and Environmental Accountability Journal*, *38*(1).
- Hummel, K., Schlick, C., & Fifka, M. (2019). The role of sustainability performance and accounting assurors in sustainability assurance engagements. *Journal of Business Ethics*, *154*(3), 733–757.
- Hussain, M., Liu, G., Yousaf, B., Ahmed, R., Uzma, F., Ali, M. U., Ullah, H., & Butt, A. R. (2018). Regional and sectoral assessment on climate-change in Pakistan: Social norms and indigenous perceptions on climate-change adaptation and mitigation in relation to global context. *Journal of Cleaner Production*, *200*, 791–808. doi:10.1016/j.jclepro.2018.07.272
- Johnsson, F., Kjärstad, J., & Rootzén, J. (2019). The threat to climate change mitigation posed by the abundance of fossil fuels. *Climate Policy*, *19*(2), 258–274. doi:10.1080/14693062.2018.1483885
- Linnenluecke, M. K., Birt, J., & Griffiths, A. (2015). The role of accounting in supporting adaptation to climate change. *Accounting and Finance*, *55*(3), 607–625. doi:10.1111/acfi.12120
- Lown, J. M. (2011). Development and validation of a financial self-efficacy scale. *Financial Counseling and Planning*, *22*(2), 54.
- Luomi, M. (2021). Climate Change Policy in the Arab Region. In *Low Carbon Energy in the Middle East and North Africa* (pp. 299–332). Palgrave Macmillan. doi:10.1007/978-3-030-59554-8_11
- Makarenko, I., & Plastun, A. (2017). The role of accounting in sustainable development. *Accounting and Financial Control*, *1*(2), 4–12. doi:10.21511/afc.01(2).2017.01
- Manokaran, K., Ramakrishnan, S., Hishan, S., & Soehod, K. (2018). The impact of corporate social responsibility on financial performance: Evidence from Insurance firms. *Management Science Letters*, *8*(9), 913–932. doi:10.5267/j.msl.2018.6.016

Roles of Accountants in Climate Change Mitigation, Adaptation, and Resilience

Markolf, S. A., Hoehne, C., Fraser, A., Chester, M. V., & Underwood, B. S. (2019). Transportation resilience to climate change and extreme weather events—Beyond risk and robustness. *Transport Policy*, 74, 174–186. doi:10.1016/j.tranpol.2018.11.003

Mi, Z., Guan, D., Liu, Z., Liu, J., Vigiú, V., Fromer, N., & Wang, Y. (2019). Cities: The core of climate change mitigation. *Journal of Cleaner Production*, 207, 582–589. doi:10.1016/j.jclepro.2018.10.034

Miles-Novelo, A., & Anderson, C. A. (2019). Climate change and psychology: Effects of rapid global warming on violence and aggression. *Current Climate Change Reports*, 5(1), 36–46. doi:10.1007/40641-019-00121-2

Mindra, R., Moya, M., Zuze, L. T., & Kodongo, O. (2017). Financial self-efficacy: A determinant of financial inclusion. *International Journal of Bank Marketing*, 35(3), 338–353. doi:10.1108/IJBM-05-2016-0065

Nordhaus, W. (2020). The climate club. *Foreign Affairs*.

O'Dwyer, B., & Unerman, J. (2020). Shifting the focus of sustainability accounting from impacts to risks and dependencies: Researching the transformative potential of TCFD reporting. *Accounting, Auditing & Accountability Journal*, 33(5), 1113–1141. doi:10.1108/AAAJ-02-2020-4445

Pakmehr, S., Yazdanpanah, M., & Baradaran, M. (2020). How collective efficacy makes a difference in responses to water shortage due to climate change in southwest Iran. *Land Use Policy*, 99, 104798. doi:10.1016/j.landusepol.2020.104798

Pelling, M., & High, C. (2005). Understanding adaptation: What can social capital offer assessments of adaptive capacity? *Global Environmental Change*, 15(4), 308–319. doi:10.1016/j.gloenvcha.2005.02.001

Pihkala, P. (2018). Eco-Anxiety, Tragedy, and Hope: Psychological and Spiritual Dimensions of Climate Change: with Karl E. Peters: “Living with the Wicked Problem of Climate Change”; Paul H. Carr: “What Is Climate Change Doing to Us and for Us?”; James Clement van Pelt: “Climate Change in Context: Stress, Shock, and the Crucible of Livingkind”; Robert S. Pickart: “Climate Change at High Latitudes: An Illuminating Example”; Emily E. Austin: “Soil Carbon Transformations”; David A. Larrabee: “Climate Change and Conflicting Future..... *Zygon*, 53(2), 545–569. doi:10.1111/zygo.12407

Ricart, S., Olcina, J., & Rico, A. M. (2019). Evaluating public attitudes and farmers' beliefs towards climate change adaptation: Awareness, perception, and populism at European level. *Land (Basel)*, 8(1), 4. doi:10.3390/land8010004

Sands, J., Lee, K. H., Schaltegger, S., & Zvezdov, D. (2015). Gatekeepers of sustainability information: exploring the roles of accountants. *Journal of Accounting & Organizational Change*.

Steg, L. (2018). Limiting climate change requires research on climate action. *Nature Climate Change*, 8(9), 759–761. doi:10.1038/41558-018-0269-8

Thomas, K., Hardy, R. D., Lazrus, H., Mendez, M., Orlove, B., Rivera-Collazo, I., Roberts, J. T., Rockman, M., Warner, B. P., & Winthrop, R. (2019). Explaining differential vulnerability to climate change: A social science review. *Wiley Interdisciplinary Reviews: Climate Change*, 10(2), e565. doi:10.1002/wcc.565 PMID:31007726

- Touma, D., Stevenson, S., Lehner, F., & Coats, S. (2021). Human-driven greenhouse gas and aerosol emissions cause distinct regional impacts on extreme fire weather. *Nature Communications*, *12*(1), 1–8. doi:10.1038/41467-020-20570-w PMID:33431844
- Twerefou, D. K., Chinowsky, P., Adjei-Mantey, K., & Strzepek, N. L. (2015). The economic impact of climate change on road infrastructure in Ghana. *Sustainability*, *7*(9), 11949–11966. doi:10.3390/s70911949
- Ung, M., Luginaah, I., Chuenpagdee, R., & Campbell, G. (2016). Perceived self-efficacy and adaptation to climate change in coastal Cambodia. *Climate (Basel)*, *4*(1), 1. doi:10.3390/cli4010001
- van Valkengoed, A. M., & Steg, L. (2019). Meta-analyses of factors motivating climate change adaptation behaviour. *Nature Climate Change*, *9*(2), 158–163. doi:10.1038/41558-018-0371-y
- Wasim, R. (2019). Corporate (non) disclosure of climate change information. *Columbia Law Review*, *119*(5), 1311–1354.
- World Health Organization. (2021). Health and climate change: country profile 2021: Fiji (No. WHO/HEP/ECH/CCH/21.01. 01). World Health Organization.
- Xu, J., & Han, R. (2019). The influence of place attachment on pro-environmental behaviors: The moderating effect of social media. *International Journal of Environmental Research and Public Health*, *16*(24), 5100. doi:10.3390/ijerph16245100 PMID:31847235
- Zamasiya, B., Nyikahadzoi, K., & Mukamuri, B. B. (2017). Factors influencing smallholder farmers' behavioural intention towards adaptation to climate change in transitional climatic zones: A case study of Hwedza District in Zimbabwe. *Journal of Environmental Management*, *198*, 233–239. doi:10.1016/j.jenvman.2017.04.073 PMID:28463773

Chapter 23

Climate Change Risk and the Performance of South African Banks

Babatunde Samuel Lawrence

University of KwaZulu-Natal, South Africa

Mishelle Doorasamy

University of KwaZulu-Natal, South Africa

ABSTRACT

The comprehensive climate risk index (CRI) is used to proxy climate change risk in this chapter as an independent variable alongside control variables such as credit risk/nonperforming loan (CRISK), total asset (TA), leverage (LEV), net income margin (NIM), capital adequacy ratio (CAR), yield on earning assets (YEA), and gross domestic product (GDP). Return on assets (ROA) as the response variable was used as proxy for performance of the top six listed South African banks on the Johannesburg stock exchange. Using Stata in a multiple regression technique for the period 2006 to 2019, this chapter concludes that the CRI is negative but not significant enough to impact performance of banks; however, its different individual components such as drought index, rain-waterlogged, etc. could be computed and regressed with other profitability measures to investigate their impact on performance of the banks in future editions of this book.

INTRODUCTION

In credit risk management, development of new climate risk product, and climate-related financing and investment, the bank's role can never be overemphasised. However, on the adverse side, banks could face credit risks because policies to cut emissions can give rise to high costs for carbon-intensive industries and firms. Volatility in the price of carbon markets (such as coal, CO₂, oil and gas) and climate-related commodities gives rise to uncertainty in financial projections (Dlugolecki & Lafeld, 2005).

DOI: 10.4018/978-1-7998-7967-1.ch023

Financial risks associated with climate change have intensified at all levels of most financial sectors in the last couple of years. At the microlevel, banks and the financial system's smooth operation and efficiency have been threatened, while at the macrolevel, the entire stability of the financial system is exposed to considerable risk. For example, it was established that over the last decade more than \$140 billion has been expended on natural disasters which is far more than the amount spent in the past three decades and additionally, over 300% increment in extreme weather events has occurred around the world (NGFS, 2020). Claims from insurance firms around the world are also estimated to be over 100% by 2085 due to increased frequency in the occurrence of events emanating from extreme weather or climate conditions (NGFS, 2020).

This has significant consequences for the financial sector while cases of extreme events as a result of distorted climate and weather conditions have occurred. An increase in these conditions is also expected soon. Hence, tackling financial risk, as a result of changes in climatic conditions, with the present monitoring and supervisory frameworks, has become very relevant. The banks in different countries have increased supervisory expectations which are centred on identifying and managing their climate-related financial risk (Feridun, 2020).

Recently, studies on climate change have focused on the existing and imminent risk for banks (Klomp, 2014; Dafermos, Nikolaidi & Galanis, 2018) and the transition costs on banks (Cui, Geobey, Weber & Lin, 2008; Huang, Unzi & Wu, 2019). On the other hand, Caldecott, Harnett, Cojoianu and Kok (2016) have investigated the financial stability of banks with respect to climate change.

There is constant pressure on banks to react to the risk of climate change. However, timeliness in receiving information that will aid in capital allocation, time management and other management tools would assist banks to be adequately prepared against climate change risk. Significant business investment has been estimated to resolve climate risk change, with global figures in the tune of US\$150 billion per year in 2010 to US\$1 trillion per year by 2030 (Jolly, 2010; UN Global Compact, 2009).

South Africa, as one of the emerging economies, projected a 20% decrease in per capita consumption as a result of climate change risk on the economy while the underdeveloped countries in Africa face a potential adverse impact of climate change, compared to other economies in the continent, because of their economic, social and environmental factors. This is because the underdeveloped economies in Africa are mostly prone to high hydroclimatic challenges (Chevalier, 2010; Houghton, 2009; Munashinghe & Swart, 2005; Schulze, 2005). This indicates an urgent necessity for an empirical study in the South African context. Moreover, conflicting studies on both companies and banks have been submitted with regards to sustainability and their financial information on climate change. Visser (2002), and Domingues, Lozano, Ceulemans and Ramos (2017) report that financial information on sustainability and climate change continues to improve on an average level. Blignaut and De Wit (2004), Burns and Weaver (2008), and Soyka (2012) posit that this information is not commonly analysed, disclosed or used in decision-making for the profit of the financial system.

Background

Deposits and investment portfolios of customers constitute major assets of banks. These bank assets may be at high risk if they are invested in high-risk sectors of the economy. The recent climate changes pose a threat to the financial health of borrowers and directly affect the credit risk of the loan portfolios of banks. The performance of banks can have a knock-down effect on the financial system. In view of this,

Climate Change Risk and the Performance of South African Banks

banks need to assess the extent of their exposure to climate risk and implement mitigation strategies to the long-term stability and sustainability of the financial service sector (CfER, 2019).

Moreover, a comprehensive understanding of the relationship between climate change and the financial system is crucial to achieving a greener future. Additionally, this understanding includes knowing the process by which the stability of the financial sector could be affected by risk and related risk from changes in climatic conditions. Moreover, institutional resilience under such risk and efficient management of climate risk are vital for all the stakeholders in the financial industry (Goodspeed, 2020). On the international scene, an initial drive was directed towards promoting the better disclosure of climate-related financial risk. For example, the task force on climate-related financial disclosures under the financial stability board (FSB) recommended the disclosure of climate-related risk and opportunities which will ascertain the potential financial impacts of climate change for stakeholders in the financial and banking communities (FSB, 2017).

The National Treasury of South Africa's allocation of funds boosts the real economy in supporting projects that bring about sustainable carbon-reduced development. The framework includes a better disclosure of green initiatives and investments to know the extent of financial exposure to climate risk by banks and other financial institutions. The urge to know the extent to which climate risk could have an impact on the profitability of banks and their financial risk exposure has been the focus of the national treasury of South Africa (NTRSA, 2020). In respect to this, financial stakeholders are now concerned about the possible negative effect of climate risk on the sustainability of financial firms. In the aim to reduce credit risk, which could emanate from climate change risk, banks have been advised to evaluate their loan-customer portfolios which could impair the financial stability of borrowers (Plochan, 2020).

This chapter aims to help understand how climate change risk influences the performance of banks. Though much research, which explores cases of opportunities arising from implementing climate change initiatives, has been conducted (Friend, 2009; Hopwood et al., 2010; Stoffberg & Prinsloo, 2009; Carbon Trust, 2011). However, few studies have empirically investigated the impact of climate change risk on the performance of commercial banks in South Africa.

Objective of the Chapter

The objective of this chapter is to establish the relationship between climate change risk and the performance of banks in South Africa. Hence, the main objective is as follows:

To estimate the impact of climate change risk on the financial performance of selected South African banks.

Contribution of Chapter

This chapter seeks to contribute to the body of knowledge concerning how climate-related risk impacts the performance of banks. The empirical findings will aid to ascertain the relationship between climate change variables and financial variables with the aid of supplying important policy implications for stakeholders in the financial and banking sector in South Africa.

EMPIRICAL REVIEW

Change in climatic conditions indicates that severe weather events, such as high rainfall, high temperatures, typhoons and droughts, may be encountered if proper pre-planned prevention is not taken. These climatic conditions tend to impact businesses negatively and the economy at large through credit risk and transition risk. Through a complex interrelationship between transition and credit risk, the credit-worthiness, operational stability and financial performance of banks and other firms can be impacted (S&P Global 2020).

Empirical findings on the impact of climate risk on the performance of banks are limited compared to studies on combined, listed companies in South Africa. Part of the problem is the inability of most banks to disclose adequate information on their climate change activities, including reports on the concentration of carbon assets in their portfolio. It has been reported that from the top banks, only Nedbank reports on carbon asset concentration (Centre for Environmental Rights, 2019). Moyo and Wingard (2015) used secondary data on 70 JSE-listed companies and compared the climate change performance with the performance indicators of these firms. They assert that the financial performance and the climate change performance of these mining companies show a direct positive correlation. The study was conducted by employing the disclosed climate change data on the global carbon disclosure project database and comparing the climate change performance of the companies to their projected and historical performance.

In China, Sun (2020) employed the climate risk index as a measure of climate risk on the performance (using ROA as a measure of performance) of listed mining companies. Employing secondary data for the period between 1995 and 2017, in a basic regression, the author established that the index of comprehensive climate risk exerts a negative impact on the performance of these mining companies, but the impact is not statistically significant. The analysis also indicates a negative correlation between climate change and the financial performance of the mining companies. It was recommended that mining companies should proactively incorporate low-carbon strategies and actively disclose information on carbon emission to the public. These actions would help to give the companies a competitive advantage in the long run and improve brand value.

As the temperature continues to rise on a global level, the impact of climate change on economic activities is important to understand (Dell et al., 2014). In 2014, the intergovernmental panel on climate change posits that certain sectors of the economy, such as fishing, agriculture, mining and forestry are often affected by extreme climate conditions. Therefore, they are predisposed to the risk of climate change because they are directly dependent on their environment for production. However, sectors that are less reliant on their environment for production are also influenced by risk from climate since sectors are linked by market interplay or interconnections. Hence, a direct or indirect wide-ranging impact on the operations of all the industries is at risk, emanating from climate change (IPCC, 2014).

TCFD (2019) recommended that a scenario analysis could be employed to evaluate climate risk and requests the voluntary release of the results in an annual report, alongside the process and methods which were used for the analysis. However, most banks are still taking steps to understand the task force on the transparency procedures of climate-related financial disclosure by understanding how the loan portfolios of customers are affected by climate change.

Batten, Sowerbutts and Tanaka (2015) investigate the processes and avenues through which policies and regulations to mitigate climate change risk could adversely affect the ability of central banks in achieving their financial and monetary objectives. They posited that natural disasters, caused by weather conditions, could cause macroeconomic instability and financial uncertainty as its damaging impact is

Climate Change Risk and the Performance of South African Banks

evident in the bank's balance sheets. Also, mispricing carbon-intensive assets could occur as a result of certain restrictions in carbon emission policies and could lead to transition risk. However, a regulated transit into a low-carbon economy could be achieved if climate-related disclosures are encouraged, which would assist stakeholders to analyse the risk exposure of their invested financial assets.

In summary, the core operations, support systems and value chains for banks could face a potential threat from climate change risk, resulting in changes in their financial performance. However, Sun (2020) argues that the occurrence of climate risk is not easy to be found in the initial stage and its severity is high in the later stage. As a result, most companies are often unaware of the severity of climate change risk and hardly take effective countermeasures in time.

METHODOLOGY

Data and Data Source

Secondary data on the banks' performance, control variables and climate risk indexes were obtained from different sources, as described below between 2006 and 2019:

- In this chapter, one measure of bank performance was used: return on assets (ROA) as the dependent variable.
- Sun's (2020) unique measure for climate risk, known as the climate risk index, was used. This index contains five different types of climate change indexes, namely, high-temperature index, rain waterlogging, drought, cryogenic freezing and typhoons. The climate risk index is estimated through a non-linear function, which is normalised to derive the index weight, using the individual weights of the five indexes (Sun, 2020).
- Finally, based on existing studies on climate risk in other sectors besides the banking sector, the first set of control variables is the microlevel variables. They are the total asset (TA), credit-risk ((CRISK)/non-performing loan), leverage (Lev) and yield on earning asset ratio (YoEA). The capital adequacy ratio (CAR), and net income margin (NIM) were added as new control variables while the gross domestic product (GDP) is used as a macrolevel control variable.
- The dependent, independent and microlevel variables were extracted from the Capital I Q database. The Capital IQ database is a provider of financial data feeds and analysis tools with a database of JSE, many other stock markets and companies' information around the world.
- The macrolevel variable is obtained from Statistics South Africa and the climate risk index (CRI) variable for South Africa is collected from the Global Climate Risk Index yearly publication by German Watch via www.germanwatch.org/en/cri

Population and Sample Size

Five South African Banks hold up to 90.5% of the total banking assets which are worth an excess of R5.6 trillion in a total asset. These banks are Standard Bank, Amalgamated Bank of South Africa (ABSA), First National Bank (FNB), Nedbank, and Investec Bank (CfER, 2019). Capitec Bank was included in this chapter because it is one of the fastest-growing banks in the retail sector in the country. Therefore,

in this chapter, we carefully selected the aforementioned six banks out of the 18 SARB (South African Reserve Bank) licensed or registered banks in South Africa.

Model Setting

The response variable in the model below is the financial performance of the JSE-listed banks which is measured by return on assets (ROA), and the dependent variable is the comprehensive climate risk index of South Africa. In this chapter, the comprehensive climate risk index (CRI) is adopted as a measure of climate risk and is employed alongside some control variables. The basic model is as follows:

$$ROA_{it} = \alpha_0 + \alpha_1 \log CRI_{it} + \alpha_2 CRISK_{it} + \alpha_3 \log TA_{it} + \alpha_4 \log GDP_{it} + \alpha_5 LEV_{it} + \alpha_6 NIM_{it} + \alpha_7 CAR_{it} + \alpha_8 YoEA_{it} + e_{it}$$

ROA in empirical studies (Aliabadi, Dorestani & Balsara, 2013) has been widely employed as a sound measure of bank performance measure, and as response variables in studies such as (Ndoka and Islami 2016; Gizaw et al (2015)). The response (control) variables (CRISK), (LogTA) and (LogGDP), have been widely used and known to impact bank performance (Menicucci & Paolucci, 2016; Mokatsanyane 2016). While (CAR) and (LEV) has show both positive and negative impact on performance of banks (Lawrence B, Doorasamy M & Sarpong P, 2020; Bhattarai 2016) and (Alshatti 2015) respectively. High (NIM) is known to increase the operating expense of firms and hence have a negative impact on performance (Jour 2013), as yield on earning assets (YoEA) helps bank regulators to ascertain the amount of interest or cash that could be generated from the assets of banks, therefore it is a solvency ratio that keeps bank's business running (Kenton 2020). We employ YoEA as a solvency ratio measure to determine its impact on performance.

Statistical Estimation Techniques Applied

The descriptive statistics of the whole data set was estimated to obtain the minimum and maximum values, mean, variance and standard deviation, which are important in result analysis. The correlation of the variable was also estimated to show how they correlate.

Multiple regression analysis was used in this chapter to quantify the relationship between a single explanatory variable and a response variable (Albright, Winston & Zappe, 2004).

EMPIRICAL RESULTS AND DISCUSSION

Table 2 above shows the descriptive statistics of the data for this chapter. The natural logarithm of GDP and log of total assets gave the highest values of all variables for the statistic while the leverage ratio gave the least values for all the descriptive measures. Capital adequacy ratio yield on earning assets, credit risk and leverage ratio gave zero as minimum values due to data inadequacy because some of these banks did not capture the data information on their financial statements at the time of sourcing.

Climate Change Risk and the Performance of South African Banks

Table 1. Variable definition

Type	Code	Name	Description
Dependent variable	ROA	Return on asset	Financial performance
Explanatory variable	CRI	Comprehensive climate risk index	Yearly indices of the different normalised climate measures.
Control variable	CRISK	Credit risk	The ratio of non-performing loan to total loan.
Control variable	LogTA	Total asset	Log of total assets of the banks on an annual basis.
Control variable	LogGDP	Natural logarithm of the gross domestic product	Economic development
Control variable	LEV	Leverage	The ratio of total debt to the total asset of the bank. It shows the ability of the bank to repay its debts through its assets.
Control variable	NIM	Net income margin	Financial performance
Control variable	CAR	Capital adequacy ratio	The ratio of the bank's capital to its risk.
Control variable	YoEA	Yield on earning assets	Financial solvency ratio. It is a measure of how much income assets are bringing to the bank.

From Table 3, a correlation of -0.0134 between ROA and logarithm of CRI signifies a negative correlation between both variables but with a p-value of 0.9035. It illustrates that such correlation is insignificant. However, climate change risk has the potential to decrease the performance of banks. Therefore, as climate risk increases, banks struggle to remain profitable; hence, their sustainability is threatened. The correlation result also shows that both CRISK and logarithm of the total asset are both significantly correlated with the performance of the banks as measured by ROA with correlations of 0.6056 and -0.8194 respectively, while other control variables are negatively correlated with performance and are statistically insignificant.

Table 2. Descriptive statistics of variables

Variable	Obs	Mean	Std. Dev.	Min	Max
ROA	70	2.522797	2.388448	0.7905	11.2114
CRI	70	54.07714	18.55568	23.08	85.67
Log TA	70	874660.6	587092.6	1251.272	2275589
Log GDP	70	338.7564	43.0679	271.64	416.42
CRISK	70	4.541677	2.472476	0.0000	11.2987
Log LEV	70	0.1956286	0.2604712	0.0000	2
YoEA	70	0.4991782	0.5331697	0.0000	1.133801
CAR	70	3.047379	5.773107	0.0000	16.7
NIM	70	4.860492	9.359139	0.114416	28.889

Climate Change Risk and the Performance of South African Banks

Table 3. Correlation result

	ROA	LogCRI	CRISK	LogTA	LEV	NIM	CAR
ROA	1.0000						
LogCRI	-0.0134	1.0000					
	0.9035						
CRISK	0.6056	-0.0314	1.0000				
	0.0000	0.777					
LogTA	-0.8194	0.0064	-0.3707	1.0000			
	0.0000	0.9543	0.0005				
LogGDP	-0.0933	-0.3148	0.0785	0.1346	1.0000		
	0.3986	0.0035	0.4779	0.222			
LEV	-0.0847	-0.1873	0.0576	0.225	-0.1202	1.0000	
	0.4437	0.088	0.6082	0.0396	0.2761		
NIM	-0.1321	-0.0166	0.254	0.2084	-0.0277	0.1126	1.0000
	0.231	0.8812	0.0197	0.0572	0.8028	0.308	
CAR	-0.1322	0.0013	-0.0875	0.3608	0.4589	-0.2044	1.0000
	0.2306	0.9906	-0.4287	0.0007	0.0000	0.0622	

Table 4. Regression result for model

R-sq:					
Within	0.6114		Min	=	13
between	0.9870		Avg	=	13.8
Overall	0.9327		Max	=	14
		Wald chi2(8)	=	830.98	
corr(u_i, X)	= 0 (assumed)	Prob > chi2	=	0.0000	

ROA	Coef.	Std. Err.	Z	P>z	[95% Conf.	Interval]
CRI	-0.003813	0.004171	-0.91	0.361	-0.011988	0.0043621
GDP	0.0020863	0.001868	1.12	0.264	-0.001575	0.0057476
CRISK	0.0007751	0.04882	0.02	0.987	-0.094911	0.0964606
LEV	0.0408958	0.323774	0.13	0.899	-0.59369	0.6754816
LogTA	-2.921935	0.186062	-15.7	0.000	-3.28661	-2.55726
NIM	0.0106517	0.010984	0.97	0.332	-0.010876	0.0321791
YoEA	-0.511165	0.178538	-2.86	0.004	-1.1828849	-0.161237
CAR	0.0500171	0.016526	3.03	0.002	0.0176277	0.0824065
_cons	18.55753	1.229316	15.1	0.000	16.14812	20.96695

Note: ***, **, * denote significance at 1%, 5%, 10% respectively

Climate Change Risk and the Performance of South African Banks

Table 4 reports the result of the regression of climate change risk on the financial performance of South Africa's top six listed banks on the JSE. The impact of CRI on the performance of these banks is insignificant. A reason for this could be that the effects of different indexes may offset one another since some climate change risk types may be positive while others may be negative (Sun, 2020). From the table, it is also established that a 1% increase in comprehensive climate risk index results in a 0.0038128% decrease in performance, as measured by ROA.

Leverage is positively correlated with the financial performance of the listed banks, as a 1% increase in leverage results in a 0.0408958% increase in performance of the banks, as measured by ROA. The higher the performance of the leverage ratio, the better the company's performance since the banking industry business requires large capital investment which may take a while to mature. The scale or size of the banks (LogTA) is significantly and negatively correlated with the financial performance of the banks at a 1% significance level, as a 1% increase results in a 2.9219% decrease in performance, as measured by ROA. This could be due to the large scale of the listed banks. The expansion of the scale could lead to a significant increase in the difficulty of internal management, resulting in increased cost and a decline in profits.

Credit risk, which is a measure of the ratio of a non-performing loan to a total loan, is positively insignificant to performance, as measured by ROA. Therefore, a 1% increase in credit risk results in a 0.0007751% increase in performance. The yield on earning asset is negatively significant at the 1% level, as a 1% increase in YoEA results in a 0.5111% reduction in performance, as measured by ROA. This could be a result of the inability of the banks to use their earning assets efficiently. The capital adequacy of the banks is significantly and positively correlated to the performance of banks. A 1% increase results in a 0.05% increase in performance. A reasonable and obvious reason for this is that the more capital equipped a bank is, the more its capacity to invest and stabilise in financial turbulence.

The net income margin has a positively insignificant correlation with bank performance because a 1% increase in NIM results in a 0.0106% increase in performance, as measured by ROA. Likewise, the measure of economic development is positively but insignificantly correlated with the performance of banks as a 1% increase in GDP results in a 0.0021% increase in the performance of banks, as measured by GDP.

CONCLUSION AND POLICY IMPLICATIONS

Climate change risks, as measured by the comprehensive climate risk index, affect a bank's financial performance in South Africa negatively, as shown in the correlation result but insignificantly, as established by the regression result. The insignificant but negative impact of the CRI on the performance of banks may be a result of the offsetting effect of the individual climate index of the CRI. However, this does not imply that climate risk does not have a potentially harmful effect on a bank's performance. Without no doubt, the impact of each of the climate risk indexes that comprises the CRI could significantly impact bank performance as such a possibility would be an interesting study to explore.

BOE (2019) posits that financial performance risk from climate change has two main sources, namely, physical and transition risk. The later risk involves moving towards a low-carbon economy while the former entails the risk caused by climate-related and weather-related events, such as droughts and a sea-level rise. Potentially large financial consequences, due to damage to properties, land and infrastructures, are a possible physical risk that could cause a loss in asset values and a borrower's creditworthiness. Additionally, as a result of extreme climate and weather-related events, increased insurance claims are

inevitable as some of these claims are tied down as deposits and investments in banks, which would reduce the profitability or performance level of these banks.

This chapter recommends that banks must urgently consider how to incorporate climate risk into their enterprise risk management frameworks, assess their loan-customer portfolios as the aforementioned impacts could affect the financial stability of borrowers. In such a case, climate risk would manifest as an increased credit risk for the banks. Branch office operations may be exposed to harsh weather conditions (physical impact) or banks could be negatively impacted by changes in regulations, resulting in penalties for financing high-polluting projects (transitional impact). In this case, climate risks would manifest as operational, strategic or reputational risks for banks. However, more clarity is needed on the potential financial impact of climate-related matters on banks.

Banks should use forward-looking scenario analysis and stress-testing to form a robust ERM framework. Hence, to understand the latent impact of climate risks on their businesses and borrowers, banks must incorporate climate change into their forward-looking analysis and decisions.

AREAS OF FURTHER RESEARCH

The impact of droughts, rainfall, typhoons and high-temperature indexes could be isolated and investigated to measure their impacts against the performance of banks and other financial and insurance firms.

Limitations of the Chapter

The disclosure of climate-related financial information is still insufficient for investors. The availability of climate-related data for most banks is a huge challenge, as a universal measure to proxy climate change risk is still a task to be settled between academics and industrial experts.

REFERENCES

- Albright, S., Winston, W., & Zappe, C. (2004). *Data analysis for managers with Microsoft Excel*. Thomson Brooks.
- Aliabadi, S., Dorestani, A., & Balsara, N. (2013). The most value relevant accounting performance measure by industry. *Journal of Accounting and Finance*, 13(1987), 22-34.
- Alshatti, A. S. (2015). *The effect of credit risk management on financial performance of the Jordanian commercial banks*. Academic Press.
- Bhattarai, Y. R. (2016). Effect of Credit Risk on the Performance of Nepalese Commercial Banks. *International Journal of Accounting & Finance Review*.
- Blignaut, J., & De Wit, M. (2004). *Sustainable options*. UCT Press.
- Burns, M., & Weaver, A. (2008). *Exploring sustainability science: A Southern African perspective*. Council for Scientific and Industrial Research.

Climate Change Risk and the Performance of South African Banks

Caldecott, B., Harnett, E., Cojoianu, T., Kok, I., & Pfeiffer, A. (2016). *Stranded Assets: A Climate Risk Challenge*. Inter-American Development Bank.

Centre for Environmental Right (CfER). (2019). *The Truth about South African Banks and Companies and their ability to address climate change risk-Full Disclosure 5*. Retrieved on 21/01/21 cer.org.za

Chevalier, R. (2010). Integrating adaptation into developmental strategies: The Southern African perspective. In S. Bauer & I. Scholz (Eds.), *Adaptation to climate change in southern Africa: New boundaries for development* (pp. 191–192). Earthscan.

Cui, Y., Geobey, S., Weber, O., & Lin, H. (2018). The impact of green lending on credit risk in China. *Sustainability*, 2018(6), 10. doi:10.3390/s10062008

Dafermos, Y., Nikolaidi, M., & Galanis, G. (2018). Climate change, financial stability, and monetary policy. *Ecological Economics*, 152, 219–234. doi:10.1016/j.ecolecon.2018.05.011

Dlugolecki, A., & Lafeld, S. (2005). *A Publication of Allianz AG Group and WWF International*. www.awsassets.panda.org

Domingues, A. R., Lozano, R., Ceulemans, K., & Ramos, T. B. (2017). Sustainability reporting in public sector organisations: Exploring the relation between the reporting process and organisational change management for sustainability. *Journal of Environmental Management*, 192, 292–301. doi:10.1016/j.jenvman.2017.01.074 PMID:28183029

Feridun, M. (2020). *What do the Evolving Prudential Regulations on Climate Change Risks Mean for Banks?* Oxford Business Law Blog. Available online: <https://www.law.ox.ac.uk/business-law-blog/blog/2020/01/whatdo-evolving-prudential-regulations-climate-change-risks-mean>

Feyen, E. H., Utz, R. J., Zuccardi Huertas, I. E., Bogdan, O., & Moon, J. (2020) Macro-Financial Aspects of Climate Change. World Bank Group.

Financial Stability Board. (2017). *Implementing the recommendations of the Task force on Climate-related Financial Disclosures*. Retrieved on 22/01/2021 www.fsb.org/wp-content/uploads/r_121029.pdf

Friend, G. (2009). *The truth about green business*. FT Press.

Gizaw, M., Kebede, M., & Selvaraj, S. (2015) The impact of credit risk on the profitability on of commercial banks in Ethiopia. *African Journal of Caribbean Central Bank*.

Huang, B., Punzi, M. T., & Wu, Y. (2019). Do Banks Price Environmental Risk? Evidence from a Quasi-Natural Experiment in the People's Republic of China. Asian Development Bank Institute.

Ingrid Goodspeed. (2020). Climate risk – now on the agenda of South African financial sector regulators. *SA Financial Regulation Journal*. Retrieved 22/01/2021 <http://financialregulationjournal.co.za/>

IPCC. (2014). Contribution of working group II to the fifth assessment report of the intergovernmental panel on climate change. In *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects*. Retrieved from <https://www.ipcc.ch/report/ar5/wg2/>

Jour, D. M. (2013). *Net interest margins and firm performance in developing countries: Evidence from Argentine commercial banks*. doi:10.1108/MRR-05-2012-0100

- Keller, G. (2005). *Statistics for management and economics* (7th ed.). Thomson South-Western.
- Kenton, W. (2020). Yield on earning assets. *Corporate Finance & Accounting -Financial Ratios*. www.Investopedia.com
- Klomp, J. (2014). Financial fragility and natural disasters: An empirical analysis. *Journal of Financial Stability*, 2014(13), 180–192. doi:10.1016/j.jfs.2014.06.001
- Lawrence, B., Doorasamy, M., & Sarpong, P. (2020). The Impact of Credit Risk on Performance: A Case of South African Commercial Banks. *Global Business Review*.
- Menicucci, E., & Paolucci, G. (2016). The determinants of bank profitability: empirical evidence from European banking sector. *Journal of Financial Reporting and Accounting*, 14(1), 86-115.
- Mokatsanyane, D. (2016). *The relationship between political risk, credit risk and profitability in the South African banking sector*. North-West University. Vaal Triangle Campus.
- National Treasury Republic of South Africa. (2020). *A Technical Paper: Financing a Sustainable Economy*. Communication Directorate National Treasury. Retrieved 21/01/2021 Sustainability technical paper 2020.pdf
- Ndoka, S., & Islami, M. (2016). The Impact of Credit Risk Management in the Profitability of Albanian Commercial Banks During the Period 2005-2015. *European Journal of Sustainable Development*, 5(3), 445–452.
- Network of Central Banks and Supervisors for Greening the Financial System (NGFS). (2020). *Guide for Supervisors: Integrating Climate-Related and Environmental Risks into Prudential Supervision*. Available online: https://www.ngfs.net/sites/default/files/medias/documents/ngfs_guide_for_supervisors.pdf
- Noth, F., & Schüwer, U. (2018). *Natural Disaster and Bank Stability: Evidence from the US Financial System*. State Administration of Foreign Exchange.
- Roncoroni, A., Battiston, S., Escobar Farfán, L. O. L., & Martínez, J. S. (n.d.). *Climate Risk and Financial Stability in the Network of Banks and Investment Funds*. Available online: <https://ssrn.com/abstract=3356459> doi:10.2139srn.3356459
- Schulze, R. E. (2005). Adapting to climate change in the water resources sector in South Africa. In R. E. Schulze (Ed.), *Climate change and water resources in southern Africa: Studies on scenarios, impacts, vulnerabilities, and adaptation*. WRC Report 1430/1/05.
- Sun, Y. (2020). *The impacts of climate change risk on financial performance of mining industry: Evidence from listed companies in China*. Hubei University of Economics. 10. doi:10.1016/j.resourpol.202.101828
- TCFD. (2019). *The Use of Scenario Analysis in Disclosure of Climate-related Risk and Opportunities*. A technical supplement of Climate Disclosure Standard Board. Retrieved on 19/01/2021. www.tcfhub.org
- Visser, W. A. M. T. (2002). Sustainability reporting in South Africa. *Corporate Environmental Strategy*, 9(1), 79–85. doi:10.1016/S1066-7938(01)00157-9

Chapter 24

Climate Change and Entrepreneurial Financing

Ayansola Olatunji Ayandibu

 <https://orcid.org/0000-0001-5870-2388>

University of Zululand, South Africa

Makhosazana Faith Vezi-Magigaba

University of Zululand, South Africa

ABSTRACT

Entrepreneurs in emerging and developing economies face many challenges curtailing their ability to finance and grow their business ventures. Climate change provides new opportunities for entrepreneurs to gain access to finance and contribute toward more climate-resilient economies. The objective of this chapter is to outline the dimensions of entrepreneurial financing that are sensitive to levels of climate change with emphasis on the financial services sector's role in reacting to these changes. An analysis of current extant literature will be explored, and evidence supporting effective entrepreneurial financing will be used to develop a theoretical framework for climate change and entrepreneurial financing to foster a more climatic conditions-sustainable economy. The literature in this chapter indicated the need for establishing the impact of climate change on entrepreneurial financing in the financial services sector in order to provide recommendations that can direct funding more effectively towards climate-resilient activities and a more climatic conditions-sustainable economy.

INTRODUCTION

Access to financing is critical to the survival and development of SMMEs, and it is one of the main challenges that entrepreneurs in South Africa and other developing countries face (Panda & Dash, 2014). According to Fankhauser et al. (2016), climate change cannot be resolved until all developed and emerging countries make substantial investments in low-carbon technology and climate-resilient activities. As a result, access to financing has emerged as a critical component of climate change reform.

DOI: 10.4018/978-1-7998-7967-1.ch024

Furthermore, debt financing is challenging to obtain since developers are seen as a high-risk credit entity. This is due to a shortage of concrete collateral as well as a track record comparable to that of seasoned entrepreneurs (Jha & Mittal, 2020). Interest rates, according to Janse van Rensburg et al. (2011), are the average cost at which interest is charged on lent money: the proportion of the borrowed sum. Furthermore, inflation can be described as a continuous, rapid price rise, as calculated by the Index, generally the Consumer Price Index (CPI), over a certain time span, normally months or years, which can be expressed in the currency's correspondingly decreasing purchasing power (Bryan, 2020). Lower interest rates make it possible for businesses to gain access to money and wealth (Jere et al., 2015).

However, emerging-market financial markets are marked by high interest rates, which raise the initial capital expenditure pressure on urban low-carbon investment as opposed to access to financing for the same investment in a developing world (Causevic & Selvakkumaran, 2018). Chirambo (2018), on the other hand, contends that climate finance modalities should be used to encourage entrepreneurship and minimize youth unemployment in addition to strengthening climate change mitigation and narrowing the energy access gap. As a consequence, in order to boost access to resources, expand green energy deployment, encourage entrepreneurship, and decrease youth unemployment all at the same time, municipal government structures would need to implement local plans that highlight these entrepreneurial opportunities (Chirambo, 2018; Nhamo et al., 2020).

THE CORE ELEMENTS OF ENTREPRENEURIAL FINANCING

Entrepreneurship, according to Zimmerer, Scarborough, and Wilson (2005), can be described as the formation of a new enterprise in the face of difficulties and complexity in order to prosper, as well as the pooling of required resources to capitalize on identified opportunities. Based on this definition, Kearney, Hisrich, and Roche (2008) claim that entrepreneurship necessitates being innovative, risk-taking, and pragmatic. Entrepreneurship may also be described as a mindset that prioritizes opportunities over money. It is a process by which individuals search resources regardless of the resources they currently employ (Thurik & Wennekers, 2004).

Usually, friends and family funds are the primary source of finance for small and medium-sized companies in India, followed by private money lenders and the unorganized financial market, where funding conditions are still vague and interest rates are also very high. Moreover, in most situations, lenders prefer to look at the company's productive track record over the last three years, and it is apparent that small and medium-sized companies are not in a position to do so due to numerous reasons such as bookkeeping asymmetry, the family-owned nature of the industry, and lack of knowledge and experience to tap the right kind and source of funding, all of which exacerbate the difference (Jha & Mittal, 2020).

Conventional Entrepreneurial Financing

Inflation, according to (Bryan, 2020), can be described as a steady, rapid price increase, as determined by the Index usually Consumer Price Index (CPI), over a fixed duration generally measured in months or years, which can be expressed in the currency's correspondingly declining purchasing power. Inflation has been seen to have an effect on the production of SMMEs (Jere, Jere, & Aspeling, 2015). As a consequence, as the real valuation of buyers' money decreases, consumers invest fewer, which has an

Climate Change and Entrepreneurial Financing

effect on growth and prospects for businesses to build a client base. As a consequence, rising inflation has a detrimental influence on entrepreneurs.

Interest rates are described by Janse van Rensburg, McConnell, and Brue (2011), as the annual rate at which interest is paid on lent money: the percentage of the borrowed volume. Increased interest rates tend to have a moderating effect on economic activity. The country's central bank increases the credit cost (interest rate), which lowers real income and hence customer spending expansion, resulting in a lower rate of economic growth due to reduced liquidity in the economy and less demand. As a result, interest rates affect business access to finance, as this is done to hold inflation under control. Lower interest rates promote access to finance and the opportunity to access services, all of which are required for entrepreneurs (Jere et al., 2015). It has been discovered that a high prime interest rate reduces both market spending rates and the amount of capital that SMMEs will generate (Van Eeden, Viviers, and Venter, 2004).

Entrepreneurs need assistance in establishing, consolidating, and extending their operations, developing novel products, and investing in new hires or production facilities. Much of this is made possible by access to finance; however, access to finance and a lack of financial acumen continue to be problematic places for entrepreneurial development and growth (Chinomona & Mazirir, 2015). Entrepreneurs also struggle to fulfill the debt funding conditions required for longer-term growth. Typical issues involve a large number of revolving debts, a shortage of available collateral, and a lack of developed market experience. A substantial test of trust on the part of the creditor is expected in order for business people to obtain an unsecured loan solely on the basis of their character. Entry to private equity or investment capital is often constrained owing to the uncertainties of the regulatory climate and the lack of established capital markets in emerging markets (Robbie, 1998; Ammer et al., 2020).

Furthermore, access to financial services is a critical factor in addressing youth unemployment and poverty alleviation, especially among women. The problems that arise as a result of this are as follows: Most young people in developed countries lack opportunities that can be used as leverage to reduce risk. As a result, financing remains prohibitively expensive and impossible for the majority of entrepreneurs trying to create a profitable enterprise. In certain instances, ambitious entrepreneurs lack creativity or concrete concepts for the businesses they wish to create (Bauman & Lucy, 2019).

According to Thampy (2010), debt financing is challenging to achieve since entrepreneurs are seen as a high-risk credit organization. This is due to a shortage of tangible collateral as well as a lack of track record of experienced entrepreneurs. This quandary is exacerbated by information gaps between the bank and the entrepreneur (Ramla, 2018). The issue is aggravated by the reality that, in the absence of mature capital markets, entrepreneurs cannot access equity capital. Financial markets in developing countries are typically at an emerging stage, and new entrants do not find it feasible to raise money due to high transaction costs (Ammer et al., 2020).

According to research, liquidity constraints influence entrepreneurial behavior and stymie business plans. According to their findings, inheriting significant sums of money or asset sales increases the likelihood of becoming an entrepreneur and the volume of capital invested in the new venture (Viinikainen et al., 2017).

Alternative Entrepreneurial Financing

Access to finance is the biggest challenge that SMMEs face and to overcome this, almost all major countries' capital markets have realized the need for a separate exchange for the SMME segment. Al-

ternatively, crowdfunding is an innovative way of financing many creative projects, encouraging sole founders of a non-profit cultural or social enterprise to bid for funding from several investors, often in exchange for potential goods or shares (Belleflamme et al., 2014) Crowd crowdfunding is a method used to collect external funds from a wide crowd rather than from a select number of specialized donors (e.g. banks, business angels, venture capitalists) where each person contributes a small amount of the funding needed (Belleflamme et al., 2014). As knowledge asymmetry, lack of collateral is some of the problems faced by small and medium-sized businesses, this style of financing can be rectified.

The importance of crowdfunding has been emphasized by Jha and Mittal (2020) in the following ways:

- It is a direct contact between the founder and the investor through the Internet, because there is no intermediary, such as a bank, to seek a fund.
- Crowd-funding is not only an effective method for collecting money but also an important mechanism for exchanging information with the general public.
- Crowd-funding raises awareness of the initiative
- Crowd-funding aims to gain awareness that can assist with potential commercialization.

According to Lenz (2016), the most prevalent form of crowdfunding is peer-to-peer (P2P) lending, through which the Internet platform raises small amounts of money from crowded individuals to support a larger loan to individuals or businesses. The platform, unlike a commercial bank, would not take liberties on its own contractual roles. Platforms decentralize risks by disseminating them to their clients, while banks accumulate risks by taking positions on their balance sheets. P2P lending may be an alternative borrowing choice for small companies that lack equity or financial records to receive conventional bank funding since the loans given are unsecured. Crowd investment can be a replacement for seed finance for start-ups and emerging venture capitalists who have difficulties in acquiring capital from a conventional source of financing (Bocken, 2015).

Ecommerce has arisen as a digital forum for exchange between lenders and SMMEs. The fact that SMMEs have access to credit through these startups is an incredibly significant development. The data strongly highlights the importance of e-commerce in today's scenario, and finance firms and banks have begun to use them as a way of expanding credit to SMMEs (Nduji & Chris, 2020).

Small and medium-sized businesses have begun to look for P2P loans or market-based lending channels to satisfy their short-term lending needs with lower interest rates. This P2P lending is being carried out by Fintech firms. FinTech companies are improving access to financing for small and medium-sized enterprises by creating loans themselves and connecting them to banks and financial institutions. Faircent, for example, is a virtual network in which lenders and borrowers can negotiate directly without needing to go through traditional financial intermediaries such as banks, which have grown to be such behemoths that they already regulate the terms and conditions for both lenders and borrowers alike (Faircent, 2021).

The P2P lending model succeeds since, unlike banks with large overheads and thousands of staff to pay and hundreds of branches to manage. On the other hand, Fintech firms are helping to eliminate the high margins that banks and financial institutions impose on financial transactions by using digital formats that allow them to keep institutional charges at a bare minimum, enabling them to simply move those benefits on to SMMEs (Faircent, 2021).

Management Criteria for Entrepreneurial Financing

The choice of whether to pursue either the conventional or alternative entrepreneurial should be evaluated against specific management criteria. When deciding which businesses and markets to invest in, venture capitalists weigh a variety of factors. Kaminski et al. (2019) refer to three categories: internal factors (such as management quality), external factors (such as business size and consumer adoption), and execution and implementation complexity. Though internal variables are subject to asymmetric knowledge between the entrepreneur and the VC investor, external factors are subject to uncertainty, but information is not often asymmetrically dispersed so entrepreneurs may often face uncertainty. Stock options are often awarded to entrepreneurs who secure a certain amount of buyers who have bought the commodity and provided favorable reviews (Kaminski et al., 2019). This contingency reinforces the idea that VC investors can recognize external variables such as projected business size and consumer acceptance. This is appropriate considering that they have a significant effect on project profits (Kaminski et al., 2019).

Golić (2014) has identified several advantages of crowdfunding as a source of entrepreneurial financing that should be taken into account by SMMEs. Firstly Entrepreneurs may need outside assistance and funding in order to launch their company or determine the social potential of their goods. Crowdfunders, unlike corporate angels or venture capital firms, are not required to have specific market experience. The “wisdom of the crowd” statement states that a group/audience will often be more successful than individuals or teams in solving issues in a business, which ultimately means that crowdfunders can be more efficient than several individual investors (Golić, 2014).

Secondly, business angels and investment capital firms, for example, offer clients considerable influence of business decisions. Crowdfunding, on the other hand, is not required to grant those privileges to investors. As a result, when an organization raises money by investment, the founders retain the ability to make their own investment choices (Golić, 2014). Therefore, SMMEs need to take into consideration retaining management control over the company when making entrepreneurial financing decisions. Thirdly, Crowdfunding has a significant benefit over other modes of fundraising is that it eliminates spatial obstacles to investment, which ensures that the regional gap between the developer and the lender is irrelevant (Golić, 2014). Hence, SMMEs are able to investigate the benefits of removing geographical barriers to investment when making their choice of entrepreneurial financing.

Fourthly, crowdfunding will give useful signals to developers regarding the business value of the product/project they choose to begin. It is clearly claimed that demand for the commodity would be strong if it is shown that there is a high degree of interest in participating in the presented project/venture, and it is believed that investors are therefore future consumers/customers (Golić, 2014). Fifthly, the primary benefit of crowdfunding is that financiers are both future clients and ambassadors for the enterprise, assisting with its advancement across their own networks. The financier is generally associated with the initiative, being responsive to improvement and able to assist in maintaining societal understanding of the idea (Golić, 2014). This gives SMMEs the ability to directly influence the marketability of their products or services as part of the entrepreneurial financing process.

Lastly, crowdfunders lead to the development of value for the company/entrepreneur by investing in the creation of a product and refining its design. Furthermore, it helps the business to shorten the period it takes to produce innovative goods, as well as their prices, and to provide a more market-accepted commodity (Golić, 2014). Ultimately, the choice of whether to pursue a conventional or alternative entrepreneurial financing approach relies heavily on the potential of SMMEs being able to maintain and keeping costs of financing to as low a level as possible, so as to maximize profitability.

THE IMPACT OF CLIMATE RESILIENT ACTIVITIES ON ENTREPRENEURIAL FINANCING

According to Haworth, Frandon-Martinez, Fayolle, and Simonet (2016), the position of financial services in building climate resilience revolves primarily around the provision of critical services to vulnerable communities and SMMEs in order for them to respond to climate extremes and disasters.

Microfinancing

Overall, it is very likely that global climate change will have an effect on microfinance institutions (MFI). Adverse situations, such as those seen in natural disasters, droughts, floods, hurricanes, and the water levels rising endanger the resources, such as property, for many MF clients worldwide (Dowla, 2009).

Furthermore, there could be an increase in vector-borne pathogens as a result of climate change, which could have an indirect effect on the clients' portfolios. Additionally, extreme weather conditions put a greater pressure on natural resources, which could have a lot of MFI's and customers in these areas. Additionally, a large MFI infrastructure, such as cars, offices, libraries, and computer systems are likely to be impacted by natural disasters and accidents (Dowla, 2009). A portfolio of microfinance institutions would be adversely affected by climate change.

Furthermore, Microfinance provides disadvantaged individuals and small and medium-sized enterprises (SMEs) with access to essential financial resources. Microfinance enables the poor to save, start or expand a company, and safeguards against risks by making small loans with obligatory, monthly repayments to groups or individuals (Benami & Carter, 2021). Deposits, savings, transfers, money transfer, remittances, and educational and health loans are also part of microfinance schemes. Most MFIs also have 'credit plus' supplemental services such as training and skills development, agricultural advice, and health and wellness workshops (Bhuiyan et al., 2020).

Microfinance is an appealing tool for fostering climate adaptation by allowing SMMEs to diversify their livelihoods or invest more resources in their current operations to increase competitiveness and resilience. There are two major explanations why microfinance is an effective method for building climate resilience. First, MFIs have pre-existing access networks for the underserved, mainly women, who are especially vulnerable to climate change (Bhuiyan et al., 2020). Second, the essence of microfinance financing – high-volume, low-value loans – is compatible with the fundamental existence of the overwhelming majority of resilience-building acts, which would ultimately necessitate thousands of decentralized measures by SMMEs and their populations throughout their ongoing efforts to internalize climate challenges in their operations (Firpo, 2009).

Insurance

Insurance would provide SMMEs, producers, and affected households with easy access to post-disaster liquidity as well as livelihood insurance. This may be one of the most significant variables driving effective reconstruction and economic recovery after extreme weather events. In the absence of traditional catastrophe insurance mechanisms, SMMEs are unable to self-insure, often depleting their money when tragedy strikes (Carter et al., 2014).

For many developed nations, weather-index insurance offers a promising alternative to conventional agriculture insurance. Contracts are index-based, as opposed to standard indemnity-based crop insur-

ance, which guarantees that the insurer can cover a regulatory claim if rainfall falls below the prescribed level, regardless of crop damage. In other terms, index-based policy covers against liabilities incurred by damages rather than losses themselves (Carter et al., 2014). However, the development of weather index insurance markets in developed countries is fraught with difficulties. In certain circumstances, an appropriate index cannot be established because the weather data infrastructure is too underdeveloped and knowledge on climate risks is restricted. Most of this suggests the insurance companies are unable to price the danger and set a fixed cost, so no insurance is offered. In addition, if major risk exists more often, assets in such risk assessment strategies are more likely to generate higher returns (Dionne, 2013).

Mobile Banking

Mobile banking, also known as channel banking, applies to financial transactions conducted by mobile computer, which may involve online banking, a card processing scheme, mobile banking, and a point of sale. Mobile banking has the potential to reach more consumers at a lower rate and with greater versatility than traditional banking schemes based on fixed branches. This will reduce processing costs (transportation, time, ease of use, etc.) for SMMEs while providing the most efficient and affordable financial services (Krishnan, 2014).

Resilience-oriented financial resources can support all the society, in principle Conversely, two opposite dimensions are conceivable depending on the strategization selected. Stable, long-term financial resources are widespread in higher and middle-income countries, cash-transfer and financial literacy systems should be extended to all low-income households. Microfinancing and remittance services including mobile banking may help the non- or underbanked elsewhere If the overall global number of financially-served families grows, disadvantaged communities would have the ability to be more prepared for economic shocks brought about by climate change (Martin et al., 2020).

The places where these financial safety net initiatives are most important, of course, represent those where the underbanked live, and particularly women. The physical accessibility of banking services poses several problems when attempting to make use some of these resources open, although this is being overcome by the presence of mobile banking (Martin et al., 2020). Often, the immediate entry point of this remittance-receiving nations may be by utilizing financial and in-in-person facilities resources. As a result, mobile banking will help clients become more responsive to climate-related shocks; nevertheless, the existence or lack of a well-established regulatory system has a significant effect on the development of mobile banking markets and financial inclusion (Deichmann et al., 2016).

RECOMMENDATIONS

Saving and borrowing help SMMEs respond and deal with climate change shocks, but they are not necessarily available to the most vulnerable communities and SMMEs most in need of assistance. Savings or saving (via MFIs or mobile banking) might not be sufficient to cope with big shocks that affect many citizens. Rather, a variety of recent ventures have focused on creating index-based weather insurance to increase financial involvement among farmers, with a focus on the likelihood of drought (Carter et al., 2014).

When paired with early warning systems or built to provide pre-disaster compensation, these provide protection against major shocks and contribute to the development of anticipatory capacities by prepared-

ness and preparation. Furthermore, strengthening the financial sector's structure is critical in order to have the supportive climate needed to improve financial inclusion and effectiveness (Aduda & Kalunda, 2012). Advances in technology are enhancing data transmission, processing, and interpretation, allowing companies to establish low-cost delivery models and flexible risk-management practices. More policy-makers are encouraging financial inclusion by enacting legislative and public-policy improvements that safeguard customers while empowering providers. Given these remarkable accomplishments, half of the world's population nevertheless needs links to savings accounts, pensions, and other financial resources, with developed countries responsible for almost 95 percent of the unbanked (Aduda & Kalunda, 2012).

Removing regulatory and legal obstacles that may hinder the growth of the financial services industry, thus improving the country's investment risk profile and the attractiveness of private sector investment in the financial services sector. The financial services industry must focus on cost savings and greater confidence in the banking sector (including payment and security settlement systems and public credit registries). Furthermore, it is suggested that collateral registers be maintained in order to increase competitiveness in the finance sector by enabling both banks and non-bank financial firms to offer secured loans (Feldman & Wagner, 2002).

According to Feldman and Wagner (2002), Empirical research has shown convincingly that countries with better-developed financial systems experience significantly faster and stable long-term growth. In the sense of the transformation, foreign direct investment (FDI) will, of course, remain a core component of the development phase, both by technology transfer and management skills. But if a dual economy is not to take root, domestic finance needs to mature and grow – and, most significantly, for viable businesses, including small and medium-sized enterprises that produce entrepreneurship and growth, which do not have access to foreign capital markets. Here, the regulatory mechanism is relevant.

Thus, improving physical access to financial instruments for the most needy (rural residents who depend on agriculture and natural resources for a living) by using the postal network, as well as improving facilities for hosting financial agents and promoting transportation (roads and public transit). Increased availability of cell phone networks will also make financial instruments virtually available through the use of mobile banking and electronic payment technology (Mbiti & Neil, 2015). This will necessitate major expenditure in telephone networks, but research indicates that cell phone infrastructure has improved knowledge transfers, resulting in price declines. In comparison, the architecture and implementation of services such as M-Pesa may be regarded as “disruptive technology”, or an example of “creative destruction”, where M-Pesa revolutionized the money transfer in the African financial services sector (Mbiti & Neil, 2015).

Governments can help to hold service rates down by requiring the introduction of low-cost bank accounts for vulnerable individuals, which can build a stable banking environment that improves competitiveness, security, and flexibility. The establishment of financial ombudsmen may also contribute to the resolution of consumer finance issues plaguing SMMEs. Governments will cooperate with domestic financial service companies with the support of foreign development partners and sponsors. This would enable the sector to expand and scale at a low cost, and to provide products that promote risk management ethics, all while improving the environment resilience of the most disadvantaged populations and the SMMEs that serve them. Rain indices or micro-insurance plans offered by early warning providers or structured in such a way as to provide pre-disaster coverage could be increased in particular.

It is important to take advantage of the surplus of expertise and skills that the private sector can offer to creating resilience to climate change through the development of innovative financial goods and services. Furthermore, cities, non-governmental organizations (NGOs), and service providers also

have a part to play in addressing low levels of financial literacy and insufficient familiarity of financial resources for vulnerable communities. Often rural SMMEs spend and conduct financial transactions in cash. They are most inclined to borrow from families and acquaintances rather than financial firms. They might even have little to no experience buying insurance plans.

These considerations limit their ability to accumulate savings, launch or expand a company, collect capital, and access funds in an emergency. As a consequence, it was proposed that governments, in partnership with NGOs and financial services firms, work together to improve the capacity, financial literacy, and trust of SMMEs. Lessons on catastrophe risk avoidance, preparedness, and business skills could be provided (e.g. how to grow a business, taking on employees, etc.)

FUTURE AREAS OF RESEARCH

This chapter explored the core elements of entrepreneurial financing and the impact of climate-resilient activities on entrepreneurial financing. Further research may be conducted on the alignment of alternative entrepreneurial financing methods presented in this chapter with climate-resilient activities to assist SMMEs in times of climate change shocks. The climate-resilient activities identified in this chapter could also be quantitatively evaluated by surveying SMMEs in emerging markets.

CONCLUSION

This chapter highlighted vital sources of entrepreneurial finances and climate-resilient activities that can protect the livelihoods of entrepreneurial ventures. Both conventional and alternative sources of entrepreneurial financing were identified to play a critical role in dealing with adverse effects created by climate change. Furthermore, several climate-resilient activities were found to be effective in creating a more climatic conditions-sustainable economy. This chapter focused on investigating the issues surrounding entrepreneurial financing and how these relate to climate change and developing a more sustainable financial sector. Therefore, entrepreneurs need to consider the most appropriate source of entrepreneurial financing that is compatible with climate-resilient activities to ensure a more sustainable financial sector.

REFERENCES

Aduda, J., & Kalunda, E. (2012). Financial inclusion and financial sector stability with reference to Kenya: A review of literature. *Journal of Applied Finance and Banking*, 2(6), 95.

Ammer, M. A., Aliedan, M. M., & Alyahya, M. A. (2020). Do Corporate Environmental Sustainability Practices Influence Firm Value? The Role of Independent Directors: Evidence from Saudi Arabia. *Sustainability*, 12(22), 9768. doi:10.3390/s12229768

Bauman, A., & Lucy, C. (2019). Enhancing entrepreneurial education: Developing competencies for success. *International Journal of Management Education*, 19(1), 100293. doi:10.1016/j.ijme.2019.03.005

- Belleflamme, P., Lambert, T., & Schwienbacher, A. (2014). Crowdfunding: Tapping the right crowd. *Journal of Business Venturing*, 29(5), 585–609. doi:10.1016/j.jbusvent.2013.07.003
- Benami, E., & Carter, M. R. (2021). Can digital technologies reshape rural microfinance? Implications for savings, credit, & insurance. *Applied Economic Perspectives and Policy*, aepp.13151. doi:10.1002/aepp.13151
- Bhuiyan, A.B., Ali, M.J., Kassim, A.A.M., Alias, Z., & Munir, A.N. (2020). *Mission Drift and Sustainability of the Microfinance Institutions: A Methodological Review*. Academic Press.
- Bocken, N. M. (2015). Sustainable venture capital–catalyst for sustainable start-up success? *Journal of Cleaner Production*, 108, 647–658. doi:10.1016/j.jclepro.2015.05.079
- Bryan, M. F. (2020). On the Origin and Evolution of the Word Inflation. In *Handbook of Monetary Policy* (pp. 593–599). Routledge. doi:10.4324/9780429270949-44
- Carter, M., De Janvry, A., Sadoulet, E., & Sarris, A. 2014. Index-based weather insurance for developing countries: A review of evidence and a set of propositions for up-scaling. *Development Policies Working Paper*, 111.
- Causevic, A., & Selvakkumaran, S. (2018). The role of multilateral climate funds in urban transitions between 1994 and 2014. *Journal of Sustainable Finance & Investment*, 8(3), 275–299. doi:10.1080/20430795.2018.1465769
- Chinomona, E., & Maziriri, E. T. (2015). Women in action: Challenges facing women entrepreneurs in the Gauteng Province of South Africa. *International Business & Economics Research Journal*, 14(6), 835–850. doi:10.19030/iber.v14i6.9487
- Chirambo, D. (2018). Towards the achievement of SDG 7 in sub-Saharan Africa: Creating synergies between Power Africa, Sustainable Energy for All and climate finance in order to achieve universal energy access before 2030. *Renewable & Sustainable Energy Reviews*, 94, 600–608. doi:10.1016/j.rser.2018.06.025
- Deichmann, U., Goyal, A., & Mishra, D. (2016). *Will digital technologies transform agriculture in developing countries?* The World Bank. doi:10.1596/1813-9450-7669
- Dionne, G. (2013). Risk management: History, definition, and critique. *Risk Management & Insurance Review*, 16(2), 147–166. doi:10.1111/rmir.12016
- Dowla, A. (2009). *Climate change and microfinance*. Grameen Foundation.
- Faircent. (2021). *About Us*. Available at: <https://www.faircent.com/about-us>
- Fankhauser, S., Sahni, A., Savvas, A., & Ward, J. (2016). Where are the gaps in climate finance? *Climate and Development*, 8(3), 203–206. doi:10.1080/17565529.2015.1064811
- Feldman, R.A. & Wagner, N., 2002. The financial sector, macroeconomic policy, and performance. *EIB Papers*, 7(2), 13–30.

Climate Change and Entrepreneurial Financing

- Firpo, J. (2009). Banking the unbanked: Issues in designing technology to deliver financial services to the poor. In *New Partnerships for Innovation in Microfinance* (pp. 186–197). Springer. doi:10.1007/978-3-540-76641-4_11
- Golić, Z. (2014). Advantages of crowdfunding as an alternative source of financing of small and medium-sized enterprises. *Zbornik radova Ekonomskog fakulteta u Istočnom Sarajevu*, (8), 39-48.
- Haworth, A., Frandon-Martinez, C., Fayolle, V., & Simonet, C. (2016). *Climate resilience and financial services*. Academic Press.
- Janse van Rensburg, K., Brue, S., & McConnell, C. (2011). *Economics* (Southern African Edition). McGraw-Hill.
- Jere, M., Jere, A., & Aspeling, J. (2015). A study of small, medium, and micro-sized enterprise (smme) business owner and stakeholder perceptions of barriers and enablers in the South African retail sector. *Journal of Governance and Regulation*, 4(4), 620–630. doi:10.22495/jgr_v4_i4_c5_p7
- JhaP.MittalS. (2020). Scope for Alternative Financing Options to Promote Financial Access to SMEs: Evidence from India. Available at SSRN: <https://ssrn.com/abstract=3753046> doi:10.2139srn.3753046
- Kaminski, J., Hopp, C., & Tykvová, T. (2019). New technology assessment in entrepreneurial financing—Does crowdfunding predict venture capital investments? *Technological Forecasting and Social Change*, 139, 287–302. doi:10.1016/j.techfore.2018.11.015
- Kearney, C., Hisrich, R., & Roche, F. (2008). A conceptual model of public sector corporate entrepreneurship. *The International Entrepreneurship and Management Journal*, 4(3), 295–313. doi:10.1007/11365-007-0048-x
- Krishnan, S. (2014). *The power of Mobile Banking: How to Profit from the revolution in retail financial services*. John Wiley & Sons. doi:10.1002/9781118932025
- Lenz, R. (2016). Peer-to-peer lending: Opportunities and risks. *European Journal of Risk Regulation*, 7(4), 688–700. doi:10.1017/S1867299X00010126
- Martín, C., McTarnaghan, S., & Williams, J.L. (2020). *Articulating a Program for Resilience*. Academic Press.
- Mbiti, I., & Weil, D. N. 2015. Mobile banking: The impact of M-Pesa in Kenya. In African successes, volume III: Modernization and development (pp. 247-293). University of Chicago Press.
- Nduji, R., & Chris, O. (2020). Effect of e-commerce on performance of commercial banks in Nigeria (A case study of First Bank Plc, Bwari Area Council, Abuja). *Journal of African Studies and Sustainable Development*, 3(10).
- Nhamo, G., Nhemachena, C., Nhamo, S., Mjimba, V., & Savić, I. (2020). Energy Poverty in the Midst of Plenty: A Harsh Reality for Sub-Saharan Africa. In *SDG7—Ensure Access to Affordable, Reliable, Sustainable, and Modern Energy*. Emerald Publishing Limited. doi:10.1108/978-1-78973-799-820201012

- Panda, S., & Dash, S. (2014). Constraints faced by entrepreneurs in developing countries: A review and assessment. *World Review of Entrepreneurship, Management and Sustainable Development*, 10(4), 405–421. doi:10.1504/WREMSD.2014.064951
- Ramla, D. (2018). *Factors Constraining Entrepreneurs from Starting, Growing and Developing: A South African Context*, Wits University, Johannesburg, South Africa (Unpublished Masters Dissertation).
- Robbie, M. K. (1998). Venture capital and private equity: A review and synthesis. *Journal of Business Finance & Accounting*, 25(5-6), 521–570.
- Thampy, A. (2010). Financing of SME firms in India: Interview with Ranjana Kumar, former CMD, Indian bank; vigilance commissioner, central vigilance commission. *IIMB Management Review*, 22(3), 93–101. doi:10.1016/j.iimb.2010.04.011
- Thurik, R., & Wennekers, S. (2004). Entrepreneurship, small business, and economic growth. *Journal of Small Business and Enterprise Development*, 11(1), 140–149. doi:10.1108/14626000410519173
- Van Eeden, S., Viviers, S., & Venter, D. (2004). An exploratory study of selected problems encountered by small businesses in a South African context. *Journal of African Business*, 5(1), 45–72. doi:10.1300/J156v05n01_04
- Viinikainen, J., Heineck, G., Böckerman, P., Hintsanen, M., Raitakari, O., & Pehkonen, J. (2017). Born entrepreneurs? Adolescents' personality characteristics and entrepreneurship in adulthood. *Journal of Business Venturing Insights*, 8, 9–12. doi:10.1016/j.jbvi.2017.05.001
- Zimmerer, T.W., Scarborough, N.M., & Wilson, D. (2005). *Essentials of Entrepreneurship and Small Business Management*. Academic Press.

Chapter 25

Enterprise Risk Management and Climate Change: Preparing the Financial Sector in Nigeria

Olufemi Patrick Adeyeye

 <https://orcid.org/0000-0001-6211-1564>

Federal University Oye Ekiti, Nigeria

Adepoju Adeoba Asaolu

Federal University Oye Ekiti, Nigeria

ABSTRACT

The global exposure to climate change-induced risks culminating in the alteration of known environmental order and its debilitating spin effects on the key economic units in which the financial sector plays the intermediation role has raised new levels of consciousness in tackling the phenomenon. To sustain stability of the financial sector and greening of its broad spectrum of activities, there is the need for an enterprise-wide risk approach better delivered through the enterprise risk management (ERM) model. This chapter, therefore, assesses the level of preparation of Nigeria's regulatory bodies and the financial sector on how best to tackle the emerging physical, transitory and indirect risks involved; it also captured the feelers of various stakeholders via responses to the questionnaire. Among other things, the authors recommend the greening of macro-prudential regulations, dynamic monetary policies, and overall framework for the financial sector to reflect the realities of climate change.

INTRODUCTION

Managing existing and potential climate change-induced risks requires a detailed enterprise-wide approach to tackle the hydra headed phenomenon that threatens and affects every segment of human existence.

Enterprise risk management (ERM), among other things, comprises of various applications and procedures put together by entities to manage or mitigate the impact of risks facing them directly or by proxy. The point of enterprise risk does not mean creating more bureaucracy, but rather to facilitate

DOI: 10.4018/978-1-7998-7967-1.ch025

discussions (by the chief risk officer) and prioritize the real big risks (Stanton, 2017). Casualty Actuarial Society (CAS) (2003) defined ERM as the discipline by which an organization in any industry assesses, controls, exploits, finances, and monitors risks from all sources for the purpose of increasing organization's short and long-term value to its shareholders. The society conceptualized ERM as proceeding across risk types and risk management processes.

ERM, therefore, presents a holistic framework for risk management in the areas of identifying peculiar events relevant to corporate objectives (inherent opportunities and threats), forecasting their likelihood and its attendant impact, and creating effective response strategies and the follow-up processes. It is a high tone of effective internal control, taking cognizance of stakeholders' interests in understanding the various risk exposures and how it would be effectively managed. Most ERM frameworks are dovetailed into identifying, analysing responding to and monitoring risks and opportunities (cost-benefit) within the external and internal environments facing enterprises (Enterprise Risk Management Committee (ERM), 2003).

From the foregoing, it is evident that ERM's broad spectrum could provide the needed shield for financial risks and other annexed risks, but how prepared is the financial sector in Nigeria for the effects of climate change on its operations and the economy at large? This and other related challenges are captured in this chapter. According to a special report by United States Institute of Peace collated by Sayne (2011) on Nigeria, dire futures are predicted for some of the world's poorest, least prepared countries and their most vulnerable citizens. According to a report by the Bank of England (Prudential Regulatory Authority, 2016), only ten percent (10%) of banks in the UK are taking a strategic view of climate change with an average planning horizon of four years.. Meanwhile, the UK's Prudential Regulatory Authority is working towards new expectations on how banks and insurance companies could incorporate the financial risk from climate change into their governance, strategy and risk management framework while aiming at the resilience of its financial system by supporting orderly market transition to a low carbon economy.

Climate change, on the other hand, has been defined severally and differently by many authors. A large chunk of the thrust of the climate change concerns is on the issues of vulnerability, adaptation to the change, the capacity to adapt, resilience and readiness to curtail or manage it (Schneider and Sarukhan, 2000). The known aspects of climate change experienced over the years in respect of extreme weather conditions, temperature variations like heat waves in Europe, flooding in Japan and Africa, wildfires in the United States and Australia, among others are given. The increasing frequency and intensity of extreme weather conditions has brought the financial industries across the world to a regulatory spotlight. According to International Monetary Fund (2018), the global mean sea level has risen by 17-21 cm from the earliest part of the 20th century, it projected that if necessary actions are not taken to limit the effects of global warming, the sea level might rise by approximately 80 cm by the end of this century. However, we believe that what the next levels of climate change portend might remain in the imagination for now. The impact of climate change on the financial sector might not be obvious in the immediate, however, if nothing is done urgently it might not augur well with banks who might be faced with toxic assets arising from a collapse in the productive sector (prudential issues). While one might think the insurance companies could come to their rescue in terms of claims, it is not certain they have fully captured climate change-related risks in their bouquets. From a closer perspective, climate change is the alteration (natural change) or altercation (due to human activities) in climate over a period of time. It is a fact that human activities could trigger nature to act outside its original form. Therefore, activities should be geared towards checking both ends. The debilitating effects of climate change cut

across industries and fields, and as a matter of fact, it touches on all aspects of human endeavour from health to business, tourism, finance, agriculture and transportation, among others.

Climate change is viewed as the latest challenge to sustainable human development (BNRCC, 2011). It is equally noted that climate change is likely to negate the positives of Nigeria's vision 2020 and invariably her Millennium Development Goals (MDGs).

This chapter provides additional information to key stakeholders in the production (manufacturing) and financial sectors on how to best tackle the beckoning climate change risks, what to do and the role of enterprise risk management (ERM) in the management of the risks. This invariably would be part of the blueprint needed to address issues of climate change.

Projected Climate Change Impact

United States' Institute of Physics (2018) states that by year 2100 the rising sea level could cost the world about US\$14 trillion a year, while the US growth might decline by about 33.3% with the entire economy shrinking by as much as 10% (Colacito, Hoffman and Phan, 2018). On the capital market side, it is projected that 20% of the global value of listed companies could be exposed to the climate change-related risks (Howard and Hassler, 2018), while the expected losses to the pool of global investment assets in terms of its net present value (NPV) could be as high as US\$4.2 trillion by year 2100 (Economist Intelligent Unit, 2015). According to Rudebursch (2019), climate-related financial risks could affect the economy through elevated credit spreads, greater precautionary savings and in the extreme a financial crisis.

Munich Reinsurance Company (2018) records that since the 1980s, the number of extreme weather events has risen above 300% (more than triple). A study conducted by the Network for the Greening Financial System (2019) reveals that 62 million people were affected by natural disasters and about two million people had to move in 2018. Also, the counts of devastations caused by natural vulnerabilities took a spike from 249 in 1980 to 820 in the year 2019 while it is estimated that the total economic losses increased from about US\$ 60 billion in 1980, to US\$ 150 billion in 2019, with a peak of US\$350 billion in 2018 (Lagarde, 2020). Besides, developing economies (including Nigeria) have already paid more than US\$40 billion in addition to the interests paid to their creditors because of the exposure to climate change risks (Allen, 2018). This payment is believed to be the buffer required to shield the creditors against climate change exposures.

Many countries including Nigeria over the years have been experiencing a rise in sea level, increased temperature, and delayed or excessive rainfall in some regions. All these are pointers to climate change. Other developing countries like Pakistan and Colombia also had their share of the unpleasant and extreme weather conditions.

High impact of climate change would likely hit the following sectors: financial sector, agriculture (both crops and livestock), forestry, biodiversity, health and environmental sanitation, housing and human settlement zones, coastal and aquatic resources, sources of energy, border management and security architecture, education and learning, and transportation (air, rail, road, sea and so on), among others. For this chapter, focus shall be on the financial sector.

World Economic Forum (2021) still captures environmental degradation as an existential threat to humanity. This is in line with the opinion of Fabris (2020) who observed that fighting climate change is one of the biggest challenges in the 21st century. Climate challenges have come to stay but require effective management to douse its strength and reduce the annexed debilitating impacts.

Scope of the Study

The principal sectors that drive the Nigerian economy such as oil and gas, telecommunications and agriculture, among others are also the major drivers of banking and insurance businesses. The exposure of these prime sectors are also the most susceptible to climate change and the spin effects of not adequately preparing for the climate change and its effects are better imagined than experienced.

As stated above, focus here would be the financial sector with cursory look into the banking and insurance segments because of the roles they play in driving other aspects of the economy through the creation of risk assets and insuring the unsystematic risks across industries. It thus goes to say that as the driver of various sectors, if the financial sector fails to prepare, we might as well have ‘crumbs’ left at the end of the climate change episode. It is even more interesting that several aspects of risks exposures relating to climate change are yet to be captured in the risk profile covered by the insurance companies despite the fact that loans and advances extended to industries by banks are expected to be secured by these insurance companies; this is apart from non-borrowing customers who are expected to insure their operational assets. Enterprise risk management (ERM) is considered in this chapter because it covers wider spectrum than the conventional risk management.

Resources Required

The present financial considerations for climate change are grossly inadequate, which underscores Nigerian government’s low and slow preparation towards containing this natural phenomenon. The provision of resources required (human and non-human) should not rest solely on the government; while the government is expected to broaden its fiscal policies to graft in the financial issues of climate change (with Nigeria’s Treasury Single Account initiative in place), private sector and related organisations should move beyond the cut-outs for corporate social responsibility (CSR) to proper budgeting toward checking the impacts of climate change. A clear legislation on a reasonable percentage of annual budget is expected to go into this.

Selected Critical Sectors in Nigeria in View of Climate Change

The 10 selected sectors listed below are prominent in the economy of Nigeria; the sectors were chosen due to their direct or indirect contributions to the economy:

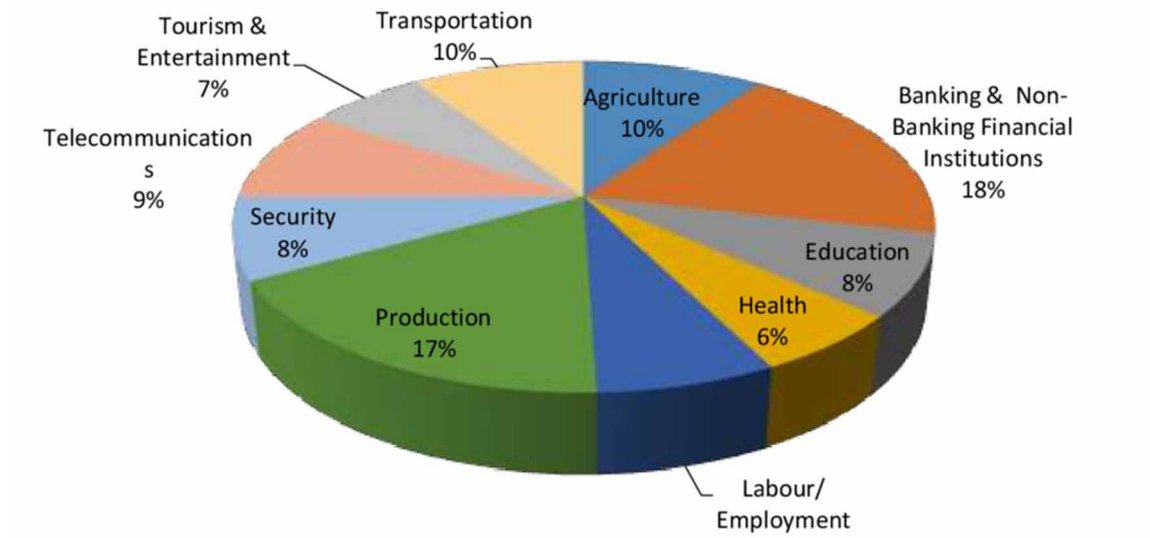
Enterprise Risk Management and Climate Change

Table 1. Selected critical sectors in Nigeria

Sector	Code	Affective Units	Percentage (%)
Agriculture	Agr.	Crops, livestock, fisheries and forestry, among others. The major impact here are reduced yields, erosion of investment values and in extreme cases, outright losses of income and agricultural land.	10
Banking & Non-Banking Financial Institutions	BNBFI	Commercial, development, specialised, merchant and microfinance banks, insurance companies, finance houses and others. The impact others are increase in bad loans and write-offs, increase in payable insurance premiums and loss or depletion of value of individual financial instruments	18.5
Education	Edu.	All learning institutions/vocations. It would result to loss in educational calendar and dearth of knowledge. The spin effect could also heighten crime rates and frustrations on the part of students who are denied.	8
Health	Hea.	Hospitals and clinics, pharmacy shops and others. On the health sector, climate change could increase medical expenses because epidemics and other diseases are not ruled out.	6
Labour/ Employment (Private & Public)	Lab.	Workforce, entrepreneurs and artisans, among others.	7
Production	Pro.	Oil and gas, mining, energy, manufacturing and others. The impact here are quite enormous, for example, the energy sector would incur carbon tax, change in the sources of energy (switch to greener sources) and closure of plants with large carbon (CO ₂) emissions. Also, working conditions at elevated temperatures would be difficult.	17.5
Security	Sec.	Banditry, crime, militancy, insurgencies and other vices. Spike in crime rate is expected, this could also be a spillover of the unemployment caused by collapse in the productive units as a result of climate change.	8
Telecommunications	Tel.	Telecommunications and allied services. Telecommunication masts and other infrastructure are going to be negatively affected. Almost every industry is going to be largely affected because they all depend on the internet or other telecommunication platforms to function well.	9
Tourism & Entertainment	Tou.	Tourism activities and entertainment. The impact would be change in tourism flow (that is low tourist patronage means low returns from the sector), this could be massive on economies dependent on tourism.	6.5
Transportation	Tra.	All means of transportation (air, land, sea). Extreme weather conditions would increase the risks and exposure of travellers to all forms of hazards, and by extension, it would impede commercial activities and movement of products, among others.	9.5
		Total	100

Authors' Compilation (2021)

Figure 1.
Authors' Design (2021)



In all of these, it is projected that there would be high incidences of capital losses in every sector due to natural disasters caused by climate change; this includes losses attributable to rising sea levels at the coastal regions.

Impact of Climate Change on the Financial Sector

There is no alternative to greening the financial sector of every nation. The word ‘greening’ should not be a mere cliché, but the one that calls for concerted efforts on the parts of all stakeholders to work up all strategies geared towards mitigating or significantly reducing the impacts of climate change on this important sector on which the economy and various industries hinge.

Climate change is one of the many structural changes that affect the financial system; while the exact outcomes, time horizon and future pathway are uncertain, there is a high degree of certainty that some combination of physical and transition risks will materialise in the future (Network for the Greening Financial System, 2019).

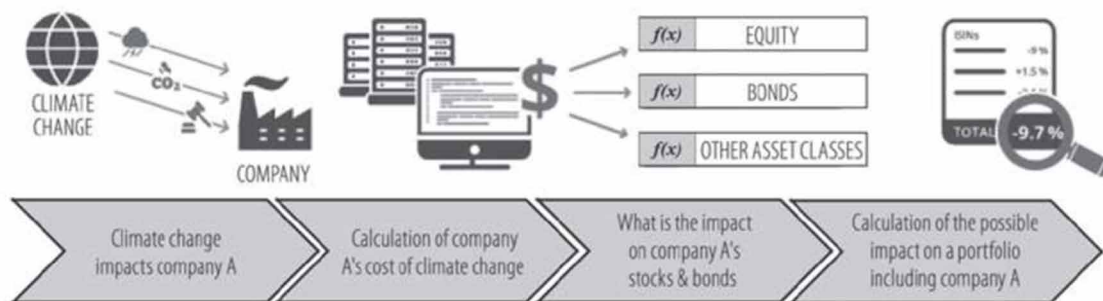
The financial industry thrives on production and commerce. The level of successes in these two sectors largely determine the going concern status of the financial sector, in other words, should the productive sector and commerce be adversely affected by the climate change, banking and other non-banking financial institutions are going to be negatively affected. Carney (2019) warned of the ‘catastrophic impact’ climate change could have for the global financial sector which is only avoidable if firms are more forthcoming in declaring their vulnerabilities and prepare to curb the negative impacts of the climate change. Furthermore, Action 100+ has described climate change as a systemic or systematic risk. Nakhoda (2010) observes that the green technology administered by the World Bank in conjunction with regional development banks has begun financing clean technology development projects in fast growing developing countries. Broadly speaking, these risks are physical risks and stranded assets (such as coals and fossil fuel derivatives, which could be passed out before their economic lifetime). Also, the

Enterprise Risk Management and Climate Change

network for greening the financial system (NGFS) harped on the roles of the financial sector in achieving the objectives of the 2015 Paris Agreement; they recognize climate change as a source of structural change in the global economy, prescribed actions central banks and supervisors could take and how policy makers could facilitate their jobs. In terms of costs-benefits of climate change, the effect is double-edged for the low end of the economy; hot weather could increase demands for cold drinks (more profit for sellers), more energy bills for using air-conditioners or freezers (more profit to electricity companies). However, providers of these services could be negatively affected by extra bills and overheads during this period, the more they are discouraged, the less they generate and less deposits in banks, and so on. Another aspect is the rainfall, if it is in the right proportion, agricultural yield would increase and in juicing the value chain, banks are happy, whereas, in the extreme cases of weather, agricultural products and livestock are endangered and any slip would be devastating to banks in terms of deposits generated or loan repayments. Furthermore, during extreme weather cases (the combination of excessive rainfall, heat, windstorms and so on) goods are damaged, shelve lives of products become unpredictable; this could cause heavy losses or high cost of production in seeking for alternatives. Lastly, the impact of sea level rise is always negative to the oil and gas facilities and coastal facilities, among others, the fact that this sector is Nigeria's economic mainstay makes it very important to take the issue of climate change seriously. Investors are prone to shying away from areas with extreme weather conditions to head off any possible negative effect on their investments.

Figure 2. Impact of Climate Change

Source: TFCF (2019) Task Force on Climate-related Financial Disclosures: Status Report, <https://www.fsb-tcfd.org/publications/tcfd-2019-status-report>.

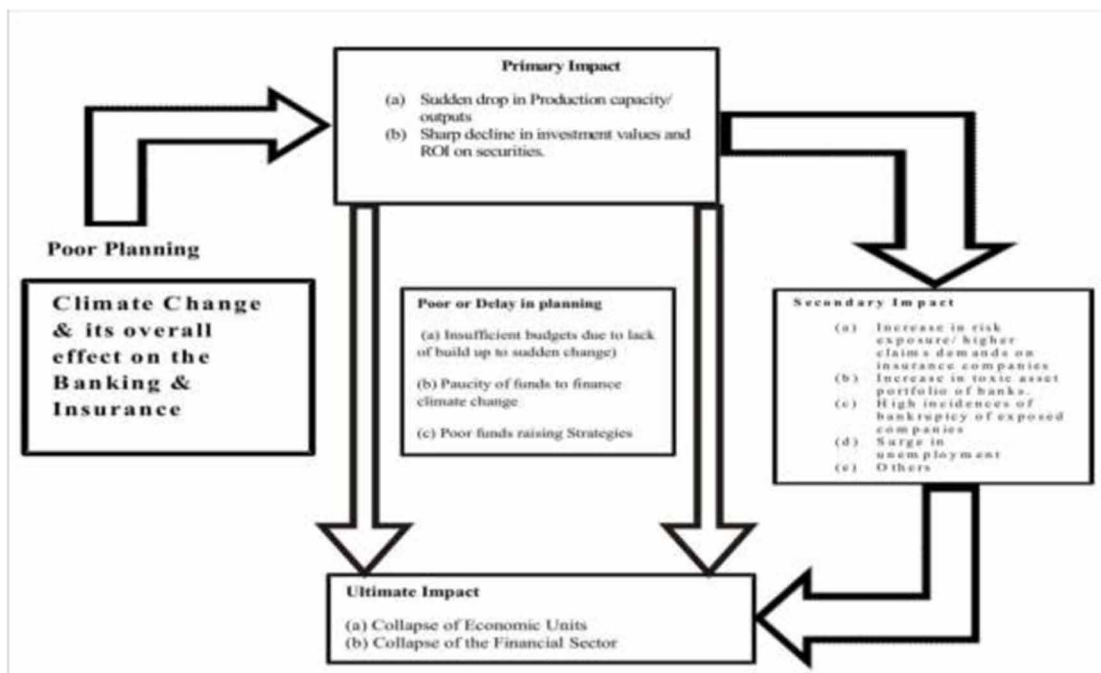


Response of Nigeria to Climate Change in Relation to the Financial Sector

Generally, in her quest for active response to climate change, the federal government of Nigeria has taken some steps to build a governance structure in response to the challenges it poses; chief among which is the creation of the Special Climate Change Unit (SCCU) under the Federal Ministry of Environment. It also mobilized an inter-ministerial coordinating committee, to cap it all, the National Assembly in 2010 passed a bill to create the National Climate Change Commission. Also, to galvanize the climate change drive are government agencies such as Nigerian Meteorological Agency (NIMET), National Emergency Management Agency (NEMA) and National Planning Commission (NPC). The government has measures

in place through her Climate Change Policy and Response Strategy with the strategic role of fostering a low carbon, high growth economic development path and to build a climate resilient society; the policy captures climate change mitigation, adaptation, climate science and technology, public awareness, private sector participation and the strengthening of national institutions and mechanisms. However, in specific terms, the policies on climate and financial institution are on paper, some banks and insurance companies mention their readiness to tackle the likely effects of climate change on the financial sector, meanwhile, little or nothing is on ground to confirm their readiness.

Figure 3. Impact cycle of climate change on the financial sector



This chapter attempts to measure the likely impacts of the climate change on the financial sector with inputs from some of the major contributors to the Nigerian economy, namely: agriculture, manufacturing, oil and gas, telecommunications and transportation. It is a fact that as the country is poised for diversification of her economy from mono-focus on oil and gas; agriculture, manufacturing, telecommunications and transportation are very important. With disruptions occasioned by climate change on transportation, there would not be any means of bringing out raw materials or products out of the farms and a bleak one for exportation. Similarly, telecommunications masts, being the sources of transmission and network, would affect basically all aspects of ICT; the manufacturing sector could lose its infrastructure to climate change, the loss arising from this portend great dangers for banks (in getting loans repaid) and insurance companies that insure such ventures. Fabris (2020) captured the effect of climate change on the financial sector in his research conclusion that climate change could adversely affect financial institutions' balance sheets, making climate change a source of financial risk. He further observed that this type of risk is yet to be given adequate attention by regulatory authorities or financial institutions over the years.

CONCEPTUAL FRAMEWORK

Below is the schematic diagram of the effects of climate change on the financial sector:

Climate Change and its Overall Effect on Banking and Insurance

The issue of climate change has become a reality that cannot be wished away. The calls in various nations for policy and regulatory re-direction to accommodate climate change are not out of place, but rather, attempts should be made to avert more devastating effects of maintaining the status quo. It is expected that modifications and actions should be taken to mitigate existing or potential climate change related risks and potential risks in order to safeguard the interests of its various stakeholders. In providing funds to tackle climate change, the financial industry should not capture it under CSR budget, but it requires a stand-alone funding captured accordingly.

Banking Industry

Climate-related financial risks refer to the set of potential risks that may result from climate change and that could potentially impact the safety and soundness of individual financial institutions and have broader financial stability implications for the banking system. These risks are typically classified as physical and transition risks (Basel Committee on Banking Supervision, 2020).

The pivotal intermediation roles of banks to various economic units cannot be overemphasized; it offers the needed wheel on which both the private and public sectors rotate. Obviously, the banking industry is not immune against the far-reaching impacts of climate change on its existence due to the potential exposures. Therefore, climate change has pervasive effect across all sectors, including the banking industry; at the individual bank's level the impacts of climate change could be on many products in a portfolio including loans, derivatives and other investments, there could also be trillions of assets (at risk) from climate change (Colacito, Hoffman and Phan, 2018). So, as the losses and costs attributable to climate change continue to rise, investment interests, depositors and other belongings of customers with them have to be adequately protected. In other words, climate risk management should become a priority, should be given adequate attention and well grafted into their annual budgets and projections. From the primary roles of banks in the areas of keeping funds (deposit liabilities) for customers making such available on demand and creation of risk assets (loans and advances) to other technical services rendered, it is evident that stability and some levels of predictability is expected to be their watchword. However, the effects of climate change, if left unchecked, could bring disaster to whatever structures that are put in place to meet customers' obligations or demand. Typically, every bank has a risk management unit that handles operational risks and credit risks, among others, but the big question is: can credit risk management alone tackle the ravaging effects of climate change? It is not likely. Hence the need to work hand-in-hand with the insurance companies, regulatory authorities, the government and international organizations at large due to the weight of the risks and the spin effects. However, this does not mean that banks would pass the entire buck of their risk profile to the insurers, but would manage in-house risks to their best potentials and pass those beyond their capacities into the enterprise-wide risk profile, which are better managed by insurance companies.

Insurance Industry

Delloite Center for Financial Services (2019) discovered that most of the United States' insurance regulators expect a spike in the various types of insurance companies' climate change risks over the medium to long term period; these include physical, liability and transition risks. Furthermore, the survey indicated that climate change would likely have a high impact on coverage availability and underwriting assumptions. With losses and potential negative consequences of climate change, insurers cannot keep procrastinating in addressing the impact of climate change on their underwriting, pricing, investment decisions, and ultimately, profitability. Due to a lot of unforeseen contingencies, insurance companies need to discover a balance between ensuring affordability and availability and managing financial stability. They should therefore deploy an all-inclusive measure to managing climate-induced risks by incorporating it into the enterprise-wide risk management template. Also, taking medium and long-term approach to managing this type of risk would provide the needed breather. Furthermore, there is need to show strong will and high level of preparedness via openness to investors, customers, public and private analysts and regulatory authorities in information dissemination and readiness for various stress testing when required. Lastly, all strategies should be flexible because of the dynamic nature of climate change.

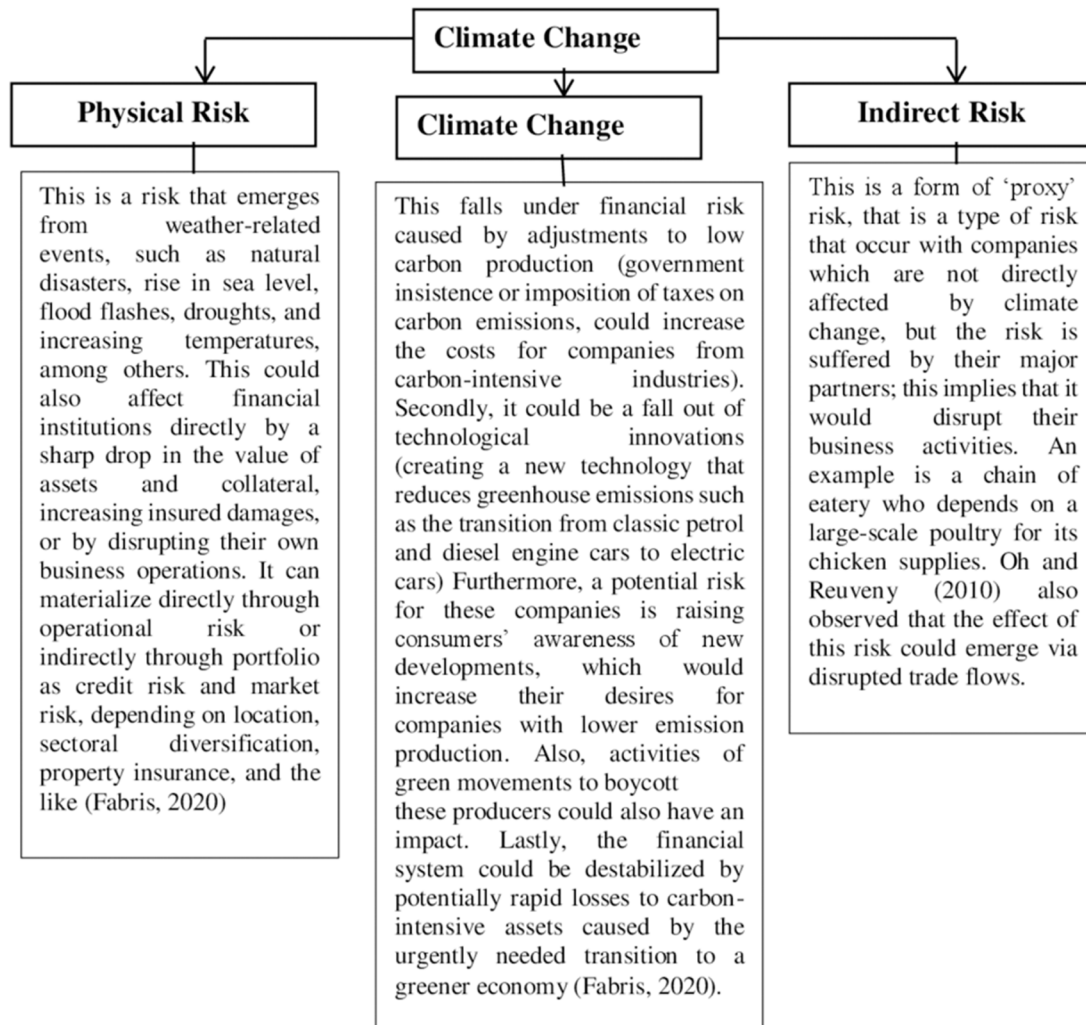
Poor/Delay in Planning

When the effects of climate change started filtering the information space, the bulk of actions and strategies were from the developed nations partly because the developing nations had a lot of challenges to grapple with. The lag between that time and when the reality dawned on the developing nations culminated in no or slow-paced planning. Climate change challenges are multi-layered and complex, which require focused, deliberate and painstaking planning. Insufficient planning and budgeting could make the impact of climatic changes appear sudden. Nigeria, for example, lost farms, homes, lives, properties and companies, among others, to rise in the sea level of some Northern and Southern states. Secondly, paucity of funds to finance climate change initiatives is another bane; over the years, the ministry of environment has not been giving the deserving priority in the annual appropriation bill. In addition, the strategies towards mopping up funds for climate change are largely limited to government efforts and few corporate commitments, whereas, there are other sources that not adequately explored such as enlisting serious commitment from international donor agencies and perhaps, raising some bonds with the primary intention to tackling existing and potential global warming challenges.

Primary Impact

Insufficient planning and paucity of funds invariably would impact the productive units of the economy; the capacity to produce becomes heavily challenged and the output arrows downwards. The spin effects include low sales/turnover, therefore, having the fixed costs constant with a decline in output implies reduction in bottom-lines, or in extreme cases, outright loss. Furthermore, if the problems become protracted, the values of investments would deplete, which invariably determines the complexion of returns on investment.

*Figure 4. Climate change risk and its overall effects on the financial system
Authors' Compilation (2021)*



Secondary Impact

Allowing climate change problems to persist unabated portend higher exposures to the insurance companies; this could escalate to a point where it may be difficult for them to fulfil their claims obligations. Also, greater exposure of the productive sector to climatic challenges could incapacitate borrowers, whose means of repayment may have been badly hit resulting into increase in toxic assets portfolio of banks; the buck of this might be passed on to the insurance companies who may have insured assets pledged as collaterals. The aggregation of all these could bring about the incidence of insolvency and bankruptcy; part of the spill over effects of a company that is aground is expansion in the labour market due to loss of jobs.

Table 2. Climate change impact on the financial system

Type of Climate Risk	Credit risk	Market risk	Operational risk
Physical	a) Increasing flood risk to mortgage portfolio b) Declining agricultural outputs	Re-pricing of sovereign debt	Impact on business continuity (going concern threats)
Transition	a) Tightening technological standards affects company business b) Carbon taxes lead to growing expenses c) Prohibition of use of outdated technologies d) Long-term investments become unprofitable e) Innovations jeopardize companies' business based on outdated technologies	Tightening climate-related policy leads to re-pricing of securities	Changing sentiment on climate issues leads to reputational risk (this could result to loss of business opportunities)
Indirect	Losses for companies connected with firms affected by climate Change	Re-pricing of securities	Low probability of negative impact (challenges with the bank's supply chains)

Authors' modification. Source: Bank of England (2018)

Ultimate Impact

When the productive sector of an economy is heavily challenged with low recovery chances from the impact of climate change, its financial sector would be badly affected; same with the economy at large. It thus goes to say that the issue of climate change and allied challenges has to be tackled headlong with proper planning and budgeting, sufficient funding, identification of possible mitigants, passage of relevant legislations and dissemination of important information to various stakeholders, among others; this holistic approach has the huge potential to break the present barriers and effect positive actions towards containing climate changes.

METHODOLOGY

Ex-post design was used in this study due to the fact that primary data were used. In line with Agbonifoh & Yomere (1999), ex-post facto research is a design for ascertaining the impact of one variable on another or more correctly, the relationship between one variable and another. In this case, we looked at the nexus of various factors on climate change that could impact the financial sector in Nigeria. The population of this study consists of 138 males and 144 females of various ages and educational backgrounds made up of banking and finance executives, customers and investors in both sub-sectors and experts on climate change and environmental studies; they were asked direct questions on climate change and its effects on the financial sector. While 400 questionnaires were distributed evenly across genders and among stakeholders in the banking and insurance sectors, we got 282 (168 and 114 for banking and insurance respectively) returned to us representing 70.5% of the total questionnaires distributed. Respondents'

Enterprise Risk Management and Climate Change

personal bio-data contains vital demographic variables such as gender, age and educational background. Meanwhile, the questionnaires were moulded into two formats: one on the banking sector and the other on the insurance sector, the aggregation of both is hereby applied.

In line with our findings, the perceptions of various stakeholders on the effects climate change were collated below:

Data Presentation

Table 3. Description of respondents (Banking sector)

No.	Statement	Response				Strongly Agree
		Strongly disagree	Agree	Not Sure	Agree	
1	Greenhouse gas flaring is directly related to financial stability and systemic risks.	0	0	7 (4.17%)	62 (36.90%)	99 (58.93%)
2	There is nexus between financial stability and climate change.	0	0	5 (2.98%)	61 (36.31%)	100 (50.52%)
3	Banks should pass the buck of climate change-related risks over to insurance companies	10 (5.95%)	50 (29.76%)	2 (1.19%)	10 (5.95%)	96 (57.14%)
4	Regulatory authorities should include climate change-related risk in her regular stress testing	0	0	0	65 38.69%)	103 (61.31%)
5	Implementation of financial and prudential guidelines in the Nigeria banking system in relation to climate change and inherent risks	0	0	1 (0.60%)	56 (33.33%)	111 (66.07%)
6	Need for regular engagements of various stake holders with climate change experts	0	0	3 (1.79%)	66 (39.29%)	99 (58.93%)

Source: Authors (2021)

DISCUSSIONS OF RESULTS AND ANALYSES

Respondents on Banking Sector and Climate Change

From *Appendix 3*, the result of our findings show that 95.83% of our respondents strongly agree/agree that there is a direct relationship between greenhouse gas flaring and financial services/systemic risks while a broader follow up question on that has 86.83% of respondents affirming the existence of a nexus between financial stability and climate change. Meanwhile, 4.17% and 2.98% of the respondents to our first and second statements were indifferent respectively. Secondly, on whether the buck of climate change-related risks should be shifted on insurance companies, a total of 53.09% strongly agree/agree while 35.71% disagree/strongly disagree with a negligible 1.19% feeling indifferent. Interestingly, on whether regulatory authorities should intensify stress testing on the banking industry on climate change-related risk and capturing the risk in prudential guidelines, 100% and 99.4% strongly agree/agree to the measures respectively. Lastly, on the need to engage stakeholders for regular briefings on climate

change, trends and implications, 98.22% of the correspondents agree on the need for such information sharing platform.

From above, it is clear that the stakeholders are primed to see positive responses from banks in the areas of tackling the seemingly intractable climate change challenges to protect their interests.

Table 4. Description of respondents (Insurance sector)

No.	Statement	Response				
		Strongly disagree	Disagree	Not Sure	Agree	Strongly Agree
1	Greenhouse gas flaring is directly related to financial stability and systemic risks.	0	0	1 (0.88%)	47 (41.23%)	66 (57.89%)
2	There is nexus between financial stability and climate change.	0	0	2 (1.75%)	42 (36.84%)	70 (61.40%)
3	Insurance companies are adequately prepared for climate change risks and has counter measures in place.	20 (17.54%)	31 (27.19%)	50 (43.85%)	10 (8.77%)	3 (2.63%)
4	Insurance companies have increased their risk profile to accommodate climate change related risks with higher absorptive capacity	20 (17.54%)	31 (27.19%)	50 (43.85%)	10 (8.77%)	3 (2.63%)
5	Employees of insurance companies & other stakeholders are trained regularly on climate change-induced risks.	0	31 (27.19%)	55 (48.25%)	20 (17.54%)	8 (7.02%)
6	Regulatory authorities should include climate change-related risk in her regular stress testing on insurance companies	0	0	12 (10.53%)	12 (10.53%)	90 (78.94%)
7	declaration and implementation of areas of climate change regulations and inherent risks covered by individual insurance companies	0	0	10 (8.78%)	13 (11.40%)	91 (79.82%)
8	Need for regular engagements of various stake holders with climate change experts	0	0	0	11 (9.65%)	103 (90.35%)

Source: Authors (2021)

Respondents on Insurance Sector and Climate Change

Appendix 4 reflects the feelings of various stakeholders who attended to our questions. On the correlation between greenhouse gas flaring, financial stability and systematic risks and by extension, a nexus between climate change and financial stability, 99.12% and 98.24% of the respondents strongly agree/agree to both assertions. This shows the importance of tackling the issues of gas flaring and related activities because of its damning implications on global warming and other climatic alterations, which invariably will affect the productive unit of the economy and financial institutions.

Enterprise Risk Management and Climate Change

Secondly, on whether the insurance companies are sufficiently prepared for the climate change with definite countermeasures, only a minute 11.4% of the respondents agree/strongly agree, whereas, 44.73% strongly disagree/disagree on such readiness, as there seems to be nothing substantial on ground to support such desirable preparedness. It is even more interesting that 43.85% take a midpoint of indifference; the same indices were reflected on the profile of insurance companies to accommodate climate change-related risks.

Moreover, on the important issue of regular training of employees and stakeholders in the insurance sector on climate change, 48.25% of the correspondents were indifferent to the enquiry, 27.19% strongly disagree/disagree that employees and stakeholders are regularly trained while 24.56% agree or strongly agree.

Furthermore, on whether regulatory authorities should be conducting regular stress testing on insurance companies especially on climate change-related risks, 89.47% strongly agree/agree because of the need to test the endurance capacities of insurance when required to face the climate change risks. Very importantly, on the issues of declaration of the state of insurance companies' risk portfolio and implementation of climate change-related regulations, 91.22% agree/strongly agree, while 8.78% feel indifferent. Lastly, on the need for global warming or climate change experts to regularly engage stakeholders, all the correspondents (100%) agree/strongly agree.

A fall out of the foregoing reveals that the existence and reality of climate change-induced risks is undeniable. Also, it has been established that the financial sector is going to be largely affected by the ravaging effects of climate change. Meanwhile, the stakeholders (from our samples) represented in our findings and feelers reflect their readiness to accept this 'new normal' by not living in denial of it, accept policies that would assist tackle the hydra-headed monster. Therefore, the federal government should intensify efforts needed to prepare the financial sector adequately well to contain the existing climate change exposures and be pro-active as other threats emerge in future. As a matter of fact, insurance companies should be supported by the regulatory authorities, the government and other stakeholders, among others to be able to develop worthwhile enterprise-wide risk models capable of tackling or mitigating the effects of climate change on the financial sector, and by extension, in the economy.

CONCLUSION AND RECOMMENDATIONS

Conclusion

With sufficient information available to the players in the financial sector, they do not need to procrastinate or think that acute consequence of climate change is not going to emerge immediately, rather, they should roll out plans and strategies to mitigate its effect, or even nip some in the bud, before such translate into uncontrollable phenomenon. We believe strongly that enterprise risk management possesses the capacity and wherewithal to take the financial sector out of the doldrums.

Recommendations

1. **Regulatory Authorities/Government:** This segment comes first because almost all that are needed to be done by other stakeholders have to be legislated to be effective. The regulations should capture all sectors with special focus on the financial system due to its importance.

- a. Various government institutions such as special climate change unit (SCCU) with the assistance of the federal government should collaborate with the relevant international institutions who are experts in tackling climate change risk to seek their knowledge and expertise for a timely solution or preventive strategies in reducing climate change impacts
 - b. To provide clear guidance and promote best practice among various banks in view of the climate change.
 - c. Greening the macro-prudential rules, monetary policy and finance framework.
 - d. The Central Bank of Nigeria (CBN) and other regulatory authorities within Nigeria's financial space should promote collaborations with global regulatory authorities on climate change in order to be able to instil best global practices in the banking and insurance sectors.
 - e. The CBN should also legislate and enforce the needed disclosure requirements on banks in respect of their climate change-sensitive assets portfolios and mitigants put in place to shield them from extreme weather scenarios. This could be an addendum to existing legislation to capture the impact of high carbon businesses.
 - f. The legislature should intensify efforts on the bill passed in 2010 that was meant to establish Special Climate Change Unit (SCCU) under the Federal Ministry of Environment and other relevant bodies such as Nigerian Meteorological Agency (NIMET), National Emergency Management Agency (NEMA) and National Planning Commission (NPC) to assess its impact so far and test the dynamics of their strategy to address potential climate change risks.
 - g. Conduct stress and adaptation testing on institutions to measure their readiness to take on the climate change challenges.
 - h. Promotion of collaborations among banks' data units and their counterparts at the CBN.
 - i. Making climate change risk a technical vocation like credit and operational risk, among others.
 - j. Compelling banks and non-bank financial institutions to regularly train specific cadres of staff on climate change because of its dynamic nature.
 - k. Determination of how climate change data collected and collated are used in risk modelling for underwriting and pricing decisions.
 - l. To penalize non-compliant institutions as deterrence to others.
2. **Banking:** All banks include deposit money banks, mortgage banks, development banks, specialised banks and micro-finance banks, among others.
- a. Beyond monetary policy and in line with the views of Derby (2019) and Randow and Skolimowski (2019), there should be a mechanism to boost banks' resilience against economic disruptions caused by extreme weather conditions.
 - b. Due to the global dimensions of climate change, leading central banks across the world have organized a network of greening the financial system with the main objective to help strengthen global response to meeting the Paris agreement and to further enhance the role of the financial system to manage risks and mobilise funds for green and low carbon investments (Network for greening the financial system). The Central bank of Nigeria (CBN) is expected to be part of this and play active roles.
 - c. There is the need to disclose clear, comparable and consistent information about risks and opportunities presented by the climate change.
 - d. It is important to intensify and encourage green bonds as alternative to high-carbon investments. This obviously would reduce banks' footprint on the carbon platforms.

Enterprise Risk Management and Climate Change

- e. Banks should not capture climate change amelioration funding under their corporate social responsibility initiatives, but make a well-planned budgets to tackle climate change.
 - f. Banks should be made to submit their medium to long-term plans and strategies to tackle the effects of climate change on their sensitive portfolios.
 - g. There should be formation of data units in various banks who will be collaborating with the CBN's data unit to assist in scenario analyses which would guide the formulation of quantitative models to handle the peculiarities of climate change across various geographies.
 - h. The CBN and Nigerian Deposit Insurance Corporation should intensify stress testing conduct on banks' credits as it relates to climate change.
 - i. There should be regular interactions with investors and customers on climate change, the trend and what the bank is doing to protect their interest; this invariably would remove panics and agitations.
3. **Insurance:** This is the most critical to the enterprise risk management and other stakeholders should give it the needed backing. It involves all cadres of insurers.
- a. Effective disclosure of exposures (risks), this would invariably assist the regulatory authorities in assessing the effectiveness of insurers in mitigating climate change-inspired insurance risks.
 - b. Insurance companies should show preparedness, readiness, willingness and the needed resilience to the cause of climate change and its potential risks by acceding to regular stress testing on them by the regulatory authorities.
 - c. Insurance companies should stratify their risks and apportion weights of importance with climate-related risks accorded a significant weight.
 - d. Deployment of its enterprise-wide risk management models would assist in containing some categories of risks, especially those beyond the conventional credit risk or operational management and this also has to do with the volume involved. Stress tests are also regularly expected to be performed on the chosen model to test its adequacy.
 - e. The following are prescribed for the insurance companies for ERM to be impactful:
 - i. They should closely with policy holders and makers to lessen the impact of climate risk exposures on their portfolio.
 - ii. As proposed in this chapter, they should take an enterprise-wide approach to managing climate change-induced risks.
 - iii. There is need to expand the profile of climate risk in each organization and prioritize it.
 - iv. There is need to use advanced and contemporary analytical tools in assessing climate risks.
 - v. They should be involved with the regulatory authorities in the formulation of climate-resilient policies due to their familiarization with the field of climatic events.
4. **Investors/Customers:** They are the major actors in funding the sector. While investors are interested in their returns on investment and other additions (such as bonuses and capital appreciation), customers who are largely depositors in banks and non-banks financial institutions want their funds provided on demand without delay or bureaucracies. Hence their role cannot be waived aside.
- a. Investors and customers alike should show a high level of willingness to garner information and data that could assist them assess their risk exposures and take timely actions.

- b. As a support toward the drive for a greener environment, they should shy away from high-carbon investments even if the returns on investment appear to be tempting, we all need a safer environment.
 - c. Talk down on greenhouse gas flaring at every given opportunity.
 - d. Make it a duty to actively participate in every stakeholder's meeting or seminars where climate issues are discussed.
 - e. Promote information and data sharing.
5. **Experts in Climate Change:** The importance of experts on climate change cannot overemphasized. Environmentalists, meteorologists and other climate experts are needed to drive home the various efforts geared at tackling the challenges posed by climate change. The financial sector needs them for information, environmental advisory services, trends and forecasts. Therefore:
- a. Experts should update their knowledge in order to be able to pass accurate and up to date information to other stake holders being served.
 - b. Experts should be willing to assist with relevant information and trends/ forecasts in order for those in need of such information not to be caught unawares by sudden effects of climate change.
 - c. Experts should be prepared to render their services from the social context.
 - d. Continuity in knowledge sharing should be a key point.
6. **Others:** It is obvious that the government and private sector alone might not be able to adequately provide finance for research and technical wherewithal, information and climate change solution. Therefore, international donor agencies and organizations should be approached to assist with needed funds with a promise to be judicious in its application.
- a. Deployment of Enterprise Risk Management (ERM) model that covers the spectrum of climate risk exposures.
 - b. Regulatory authorities, especially the Central Bank of Nigeria, Nigeria Deposit Insurance Corporation and others should re-assess the impact of physical and transitional risks of climate change on the financial sector, which is the pivot on which other economic units rotate.
 - c. Regular sensitization of stakeholders and investors on carbon risks.
 - d. Legislating actions to curb the long-term effects of global warming or to reduce green gas-es emission and damaging/anti-ecological activities with readiness to sanction companies flouting orders on gas flaring.
 - e. Positive collaborations between the government regulatory authorities, investors and other parts of the market to head off low hanging climate change risks.
 - f. On fiscal approach, the government should set apart a percentage of tax remittances, which would form a pool of funds in tackling climate change; this would reduce the burden on the annual budget on climate change.

REFERENCES

Agbanifo, B. A., & Yomere, G. O. (1991). *Research Methodology* (1st ed.). University Press University of Benin.

Enterprise Risk Management and Climate Change

- Allen, K. (2018, July 3). Countries face higher debt bills due to climate risks. *Financial Times*.
- Bank of England. (2018). *Transition in thinking: the impact of climate change on the UK banking sector*. Prudential Regulatory Authority (PRA) Report.
- Basel Committee on Banking Supervision. (2020). *Climate-related financial risks: a survey on current initiatives*. Bank for International Settlements document. www.bis.org
- Carney, M. (2019). *A transition in thinking and action*. Remarks at international climate risk conference for supervisors. <https://www.bankofengland.co.uk>
- Colacito, R., Hoffman, B., & Phan, T. (2018). *Temperature and growth: A panel analysis of the United States*. WP 19-09.
- Deloitte Center for Financial Services (2019). *Insurance Regulator State of Climate Risks Survey*. Latest news from @DeloitteFinSvcs, Sharing Insights.
- Economist Intelligence Unit. (2015). *The cost of inaction: Recognise the value at risk from climate change*. Report 2015.
- Enterprise Risk Management Committee (ERM). (2003). Overview of Enterprise Risk Management. Casualty Actuarial Society.
- Fabris, N. (2020). Financial Stability and Climate Change. *Journal of Central Banking Theory and Practice*, 3(1), 27-43. doi:10.2478/jcbtp-2020-0034
- Howard, A., & Hassler, M. (2018). Climate change: forgotten physical risks. *Schroders*.
- Institute of Physics. (2018). *Rising sea level could cost the world \$14 trillion a year by 2100*. Report.
- International Monetary Fund (IMF). (2018). *World Economic Outlook*. IMF.
- Lagarde, C. (2020). *Climate Change and the Financial Sector. Launch of COP 26 Private Finance Agenda*. <https://www.ecb.europa.eu>
- Munich Reinsurance Company. (2018). A Stormy Year: Natural Catastrophe 2017. Geo Risks Research. Munich: Munich Reinsurance Company.
- Nakhouda, S. (2010). *The clean technology fund: Insights for development and climate finance*. World Resource Institute (WRI) Working Paper. www.wri.org
- Network for the Greening Financial System. (2019). *A Call for Action: Climate Change as a Financial Risk*. [rance.fr/sites/default/files/media/2019/04/17/ngfs_first_comprehensive_report_-_17042019_0.pdf](https://www.rance.fr/sites/default/files/media/2019/04/17/ngfs_first_comprehensive_report_-_17042019_0.pdf)
- Network for the Greening Financial System. (2018). *NGFS First Progress Report*. <https://www.banque-france.fr/site/default/filesmedia/2018/10/11/818366-ngfsfirstprogress-report-20181011.pdf>
- Oh, C. H., & Reuveny, R. (2010). Climatic Natural Disaster, Political Risk and International Trade. *Global Environmental Change*, 20(2), 243–254. doi:10.1016/j.gloenvcha.2009.11.005
- Rudebursch, G. D. (2019). Climate change and the federal reserve. FRBSF Economic letter, Federal Reserve Bank of San Francisco.

Sayne, A. (2011). *Climate change, adaptation and conflict in Nigeria*. United States' Institute of Peace (Special Report 274). www.usip.org

Schneider, S., & Surukhan, J. (2020). *Overview of Impacts, Adaptation and Vulnerability to Climate Change*. Academic Press.

Stanton, T. (2017). *Enterprise risk management*. Youtube TEDxJHUUC.

World Economic Forum. (2019). *The global risks report 2019*. Report.


Chapter 26

Climate Change Accounting and Value Growth of Financial Institutions in West Africa

Haruna Maama

Faculty of Accounting and Informatics, Durban University of Technology, South Africa

Ferina Marimuthu

 <https://orcid.org/0000-0001-9205-8127>

Faculty of Accounting and Informatics, Durban University of Technology, South Africa

ABSTRACT

The study investigated the impact of climate change accounting on the value growth of financial institutions in West Africa. The study used 10 years of annual reports of 47 financial institutions in Ghana and Nigeria. The climate change disclosure scores were determined based on the task force's recommended components on climate-related financial disclosure. A panel data regression technique was used for the analysis. The study found a positive and significant relationship between climate change accounting and the value of financial institutions in West Africa. This result implies that the firms' value would improve should they concentrate and enhance their climate change disclosure activities. The findings also revealed that the impact of climate change accounting on the value of financial institutions is positively and significantly higher in countries with stronger investor protection. These findings enable us to expand our understanding of the process of generating value for investors in financial institutions and society, generally.

INTRODUCTION

The activities of firms have considerable impacts on the environment and society; hence firms are under pressure to operate responsibly. To discharge this duty, firms have been called upon to provide information on how their activities affect the environment and society and the measures put in place to mitigate such effects. This has resulted in an upsurge in interest in environmental, social and governance (ESG) report-

DOI: 10.4018/978-1-7998-7967-1.ch026

ing. ESG reporting provides information about a firm's non-financial activities such as environmental impacts and mitigation measures, climate change, carbon emission, community empowerment, employee development and governance structure. There has been a coordinated effort to promote the adoption of ESG reporting by firms, which has yielded significant results (Vitolla et al., 2019). However, climate change accounting is yet to achieve wide acceptance within the corporate reporting environment. A significant challenge to adopting climate change accounting is a lack of frameworks based on accounting principles to frame them and hence guide firms on the set of information to disclose (Gulluscio, 2020). As alluded to by Evangelinos et al. (2015), climate change reporting is mostly voluntary, with the lack of generally accepted guidelines for reporting a significant problem. The authors suggested that this led to untrustworthiness and awkwardness in climate change accounting and accountability.

The call on firms to account for their environmental and social impacts has yielded some results because firms have begun to incorporate environmental and social information in their annual reports (Abeysekera, 2013; Sief, 2014; Horvat & Korosec, 2015). Firms in developing countries have also started to account for their environmental impacts through environmental and social reporting (Thistlethwaite, 2015; De Villiers et al., 2017). However, in most developing countries, these reporting practices are voluntary yet consumes substantial amounts of a firm's resources. More surprising is that financial institutions that are not known to have any significant negative impacts on the environment and society are adopting climate change accounting (Alsaifi et al., 2020). Financial institutions can play a significant role in mitigating climate change risks, especially society's adjustment towards climate change. This is achieved through investment decisions, financing decisions, developing risk mitigation products, credit risk management policies and lending practices (Buallay, 2019). Despite banks not having any significant negative impacts on the environment and society, they adopt climate change accounting (Matuszak & Rozanska, 2017). This has triggered a debate on whether such practises are beneficial to the value maximisation of shareholders wealth.

Elsewhere, evidence shows that firms that practice climate change accounting enjoy value growth (Qiu et al., 2016; Cahan et al., 2016; Bose et al., 2017). Other studies have also portrayed climate change accounting as a challenge to companies because the practice has not only been a waste of resources; but has also failed (Marcia et al., 2015; Matuszak & Rozanska, 2017; Alsaifi et al., 2020). These conflicting findings show that the debate on the value relevance of climate change accounting is still rife. Considering this, the study investigated whether financial institutions benefit from climate change accounting. This question is crucial to the sustainability of the financial sector in West Africa because of its unique political, economic, social, cultural and legal environment. Therefore, this study investigates whether financial institutions in West Africa attain value growth through climate change accounting.

The study found a positive and significant relationship between climate change accounting and the value of financial institutions in West Africa. This result of this study implies that the financial institutions would improve their value should they concentrate and improve their climate change disclosure activities. The findings also revealed that the impact of climate change accounting on the value of financial institutions is positively and significantly higher in countries with stronger investor protection. This study contributes to the literature in many ways. First, the study shows that climate change accounting contributes to the value growth of financial institutions in West Africa. These results serve to motivate management of firms to adopt climate change accounting because it can contribute to firms' value growth. This result further broadens our understanding of why financial institutions adopt climate change accounting. Given that climate change accounting is voluntary in these countries, this study's

evidence may interest the governments and regulators to consider whether to make climate change accounting obligatory among firms.

LITERATURE REVIEW

The Concept of Climate Change Accounting and Reporting

Due to the significant impact, a firm's activities have on the environment, its climate footprint has been under scrutiny. As a result, firms are under considerable pressure to be responsible in their actions by ensuring that their activities do not negatively impact the environment (Busch & Lewandowski, 2018). One of such environmental issues that dominate the academic discussion is climate change. Climate change has become a topical issue because of global warming, linked to greenhouse gas emissions (GHG) and the rising carbon dioxide (Kilic & Kuzey, 2019). Fortunately, firms are aware that stakeholders demand them to their operations in a manner that does not negatively impact the environment. As a result, firms have integrated systems in their operations to account for their effects on climate change. This is achieved through climate change reporting or accounting. Climate change accounting is an accounting practice that considers a firm's impact on climate change, the risk posed by climate change and the measures to reduce climate change risks (Masuma et al., 2019). This implies that a firm's financial reporting should not focus only on financial information but also include information about the environment, especially climate change. Some studies regard climate change disclosures as part of social and environmental accounting.

Because of the significant role of climate change accounting, the Climate Disclosure Standards Board (CDSB) and the Carbon Disclosure Project (CDP) were established to provide material information to firms towards the integration of climate issues their business operations. Notably, the CDP piggybacked the Global Reporting Initiative Sustainability Reporting guidelines to provide information that would help firms wishing to adopt climate change reporting. The CDP is one of the initiatives by international organisations that liaises with stakeholders, including investors, government and companies, to promote responsible environmental action that would yield a sustainable economy, reduce climate change and protect the earth's natural resources (ACCA, 2013). With an agenda involving an environmental disclosure mechanism, companies are encouraged to disclose their impacts on the environment voluntarily. Hence, sustainable behaviour and ameliorating harmful impacts on the environment is promoted (Lozo, 2019).

Theoretical Review

The legitimacy theory is one of the most widely discussed theories used to explain the reasons behind firms' voluntary environmental and social disclosures (Mousa & Hassan, 2015). Through social and environmental reporting, firms' aim to gain, maintain or repair their legitimacy. The legitimacy theory suggests that firms engage in activities that positively impact the environment and their social status to get approval from society (Pellegrino & Lodhia, 2012). The theory is derived from organisational legitimacy, defined as a status or condition that exists when the organisation's value system is congruent with that of the societal value system within which it operates. The firm's legitimacy is threatened when the two value systems are in disparity; hence, firms' aim to establish congruency between their value system and the norms accepted by society (Mousa & Hassan, 2015). The legitimacy of firms' may be

threatened should they engage in activities that are not within the acceptable bounds of society, to the extent that they may be severely sanctioned by society, such as the threat of limiting their resources.

Legitimacy theory highlights that firms can be punished or rewarded based on how society perceives their activities. In this context, firms will instead choose to be rewarded by society by engaging in friendly activities to the climate and the environment, which are regarded as responsible. Organisational legitimacy depends on the firm's ability to adapt to dynamic environments and conform to the social contract, and firms would instead adjust their values to gain legitimacy from the community, ensuring their sustainability (Solikhah, Yulianto, & Suryarini, 2020). Strategies available to firms who have their legitimacy threatened include educating society of their intentions, altering society's perception towards their actions, diverting or manipulating society's attention, and amending society's expectations (Gulluscio et al., 2020). In the paper's conception, the legitimacy theory has the role of explaining firms' behaviour in voluntarily disclosing climate change information to fulfil their social contract and improving their financial performance. Hence, this study draws on the legitimacy theory to explain West African financial institutions' behaviour and how they may financially benefit from such behaviours.

Empirical Literature Review

Empirical evidence provides mixed results when investigating the impact of climate change accounting on firms' performance. These results can be broadly categorised as one of the following: positive impact, no impact, and negative impact. However, the majority of the studies support the view that climate change reporting is positively related to the financial performance of firms. For instance, Zamora-Ramirez and Gonzalez-Gonzalez (2015) investigated the relationship between climate change reporting and Spanish firms' financial performance. The authors found that the market responded favourably to the disclosure of climate change information, which had an incremental effect on the firms' financial performance. Aligned to this finding, Schadewitz and Niskala (2010) investigated the relationship between corporate social responsibility reporting and firms' market value and found a positive relationship between these variables. Similarly, Qiu et al. (2016) assessed the link between social and environmental reporting and firms' performance in the UK. The authors adapted Olhson's model and demonstrated that social reporting positively correlates with firms' performance. The authors further found that environmental reporting had no relationship with the performance of firms in the UK. Cahan et al. (2016) and Bose et al. (2017) also found a positive relationship between social and environmental reporting and firms' performance. These results confirm that firms with environmental or quality climate change reporting practices have better financial performance.

On the other hand, another stream of literature challenges the view that climate change disclosure is beneficial to firms. This stream of literature argues that climate change disclosure increases the cost of operation, which reduces profits. For instance, the evidence provided by Buallay (2019) showed that environmental reporting has a negative impact on firms' performance. Buallay's (2019) evidence proved that firms suffer financially by practising environmental accounting. Similarly, Marcia et al. (2015) found that environmental, social, and governance (ESG) reporting value is relevant, especially when stakeholders demand financial returns conflict with the ESG imperatives. This view is supported by Matuszak and Rozanska (2017). These authors conducted a study in Poland, which investigated the link between social accounting and firms' performance and found that social accounting has a negative association with the financial performance of firms. A similar study conducted by Alsaifi et al. (2020) examined how the market responded to climate disclosures in the United Kingdom. The study found that

the market responded negatively to climate change disclosures, suggesting that climate change reporting did not benefit the firms. These studies view environmental accounting (climate change accounting) as a waste of resources, which negatively impacts firms' performance.

Other studies also found no relationship between environmental or climate change accounting and the performance of firms. First, Adegboyegun et al. (2020) examined the impact of integrated reporting on the financial performance of banks in Nigeria. They found that integrated reporting had no significant relationship with banks' financial performance. Similarly, in a study conducted in Jordan, Al-Dhaimesh, and Al Zobi (2019) found no significant relationship between environmental accounting and banks' financial performance. Another study conducted by Banghoj and Plemborg (2008) also found that climate change reporting (voluntary disclosure) had no relationship with firms' financial performance. Murray et al. (2006) also found no relationship between environmental/social reporting and the financial performance of firms in the UK.

Generally, the evidence provided by these studies appears to show a lack of consensus on the relationship between climate change reporting and firms' performance. As the climate crisis looms, the essential action today's regulators can take is to require the financial sector to measure and disclose the carbon emissions of their financial portfolios. The financial sector can mitigate the impact of the climate crisis by financing cleaner alternatives aligned with a low-carbon, resilient society. This view is important because evidence has shown that firms' practising climate change accounting enjoys value growth (Qiu et al., 2016; Cahan et al., 2016; Bose et al., 2017). However, while an increased long-term investor base is seen as a benefit, the costs involved in investing in improved information systems for sustainability data, acquiring expertise to use and integrate the data in financial reporting, and increasing organisational cross-functional collaboration to produce the integrated report, cannot be ignored. These conflicting views occasioned the conduct of this study to examine whether climate change is value relevant to financial institutions in West Africa.

METHODOLOGY

The study used the annual reports of financial institutions in West Africa. The financial institutions comprised banking and insurance firms. However, only firms listed in English-speaking countries were selected. The countries comprised Gambia, Ghana, Liberia., Nigeria and Sierra Leone. However, Gambia, Liberia and Sierra Leone were excluded because they had no stock exchange. Ghana and Nigeria were subsequently used for the study. The listed financial institutions were used because the public has high stakes and interest in them through personal resources, pension funds and general portfolio. Also, since these companies are publicly traded, they face more public scrutiny concerning their activities and reporting obligations. The two countries together had sixty-one (61) listed financial institutions, comprising Ghana (10) and Nigeria (51) as of 31 December 19. However, fourteen (14) firms in Nigeria were excluded because of missing data. Consequently, a total of forty-seven (47) financial institutions were included in the study, which was allocated as follows: Ghana (10) and Nigeria (37). Annual reports covering ten years (from 2010 to 2019) were used for the study. Based on this, four hundred and seventy (470) annual reports were targeted. Twenty-eight (28) annual reports were missing, resulting in the use of four hundred and forty-two (442) annual reports. The annual reports were the source of both climate change disclosure information and the financial data of the firms.

Measurement of Climate Change Accounting Disclosure Scores (CCADS)

The climate change accounting disclosure scores (CCADS) were collected through a content analysis method. The CCADS was created according to five components. The first component or elements was based on any mention of climate change in the firms’ annual reports. The other elements comprised the four recommended disclosure areas suggested by the Task Force on Climate-related Financial Disclosure [TCFD] (2017). Each of the five components was calculated based on a content analysis method. A content element analysis method is an accepted method embraced by researchers for climate change and ESG accounting (Esch et al., 2019; Lozo, 2019; Aggarwal & Signg, 2019). Content analysis is a research tool employed to quantify words and texts according to themes and concepts. Following the research of Lozo (2019), the climate change accounting disclosure scores were calculated based on the following equation:

$$CCADS = Mention_i \times w_1 + Govern_i \times w_2 + Impact_i \times w_3 + Plan_i \times w_4 + Metric_i \times w_5$$

Where

‘i’ denotes the individual companies; ‘w’ represents the weight of the individual elements in CCADS. Each weight equals 20%. Therefore, the subsequent score for each company ranges from 0 to 100 for the sampled firms.

The five elements of the CCADS and their calculations are explained in Table 1.

Table 1. Description and calculations of CCADS

Elements	Description	Nature
Mention	This indicates whether a firm mentions climate change in its annual report.	Qualitative 1 if yes, 0 if no
Govern	This shows whether a firm discloses the role of management or board in examining or managing climate risks and opportunities	Qualitative 1 if yes, 0 if no
Impact	This indicates whether a firm discloses particular risks or opportunities generated by climate change (e.g. physical, regulatory or market risks). Aligns with the ‘Strategy’ metric of TCFD (2017).	Qualitative 1 if yes, 0 if no
Plan	This specifies whether the report mentions an action plan to mitigate climate risks and/or benefit from new opportunities. Aligns with the ‘Risk Management’ metric of TCFD (2017).	Qualitative 1 if yes, 0 if no
Metric	This shows whether a firm discloses any metric and targets to manage risk and opportunities, including its contributions to climate change (i.e. Greenhouse Gas Accounting).	Qualitative 1 if yes, 0 if no

Source: Lozo (2019)

Econometric Method

A panel data analysis was used to estimate the impact of climate change accounting on the value of financial institutions in West Africa. Adapting the studies of Ohlson (1995), de Klerk and De Villiers (2012), Qiu et al. (2016) and Zhao et al. (2018), the following models were developed for the estimation of the parameters of the model. Model 1 estimates the impact of climate change accounting on the

value of financial institutions. On the other hand, model 2 estimates whether the strength of a country’s investor protection influences the relationship between climate change accounting and firms’ value.

$$\text{TobQ}_{it} = \beta_0 + \beta_1\text{CCADS}_{it} + \beta_2\text{BVPS}_{it} + \beta_3\text{EPS}_{it} + \beta_4\text{IP}_{it} + \beta_5\text{EcoSize}_{it} + \beta_6\text{MgtEff}_{it} + \beta_7\text{Size}_{it} + \epsilon_{it} \quad (1)$$

$$\text{TobQ}_{it} = \alpha_0 + \alpha_1\text{CCADS}_{it} + \alpha_2\text{BVPS}_{it} + \alpha_3\text{EPS}_{it} + \alpha_4\text{IP}_{it} + \alpha_5\text{CCADS}_{it} * \text{IP}_{it} + \alpha_6\text{EcoSize}_{it} + \alpha_7\text{MgtEff}_{it} + \alpha_8\text{Size}_{it} + \epsilon_{it} \quad (2)$$

The following are the explanations of the variables.

‘i’ represents the number of firms, and ‘t’ is the time period. TobQ_{it} represents Tobin’s Q growth (proxy for firms’ value) of firm *i* at time *t*. Tobin’s Q was measured by the ratio of the firms’ total market capitalisation to their total asset value. CCADS_{it} denotes the climate change accounting disclosure scores of a firm ‘i’ at time ‘t’. The BVPS_{it} refer to the book value per share of firm ‘i’ at time ‘t’ and EPS_{it} denotes the earnings per share of firm ‘i’ at time ‘t’. The IP_{it} represents the investor protection index, measured by the World Economic Forum’s index for the strength of investors protection of a country. This ranges from ten (10) to one (1); 10 being the highest form of investor protection. Also, EcoSize_{it} represents the natural logarithm of the gross domestic product of a country whilst MgtEff_{it} denotes the management efficiency of a bank ‘i’ at time ‘t’, which is measured as total revenue divided by the average total assets. Moreover, the Size_{it} represents the size of a bank ‘i’ at time ‘t’, which was measured as the natural logarithm of total assets of the banks. Finally, β and α are the coefficients of the variables, ϵ_{it} is the stochastic error term at time ‘t’.

RESULTS AND DISCUSSION

This section presents the results of the analysis conducted. Table 2 shows the summary statistics of the variable.

Table 2. Summary statistics

	Observations	Mean	SD	Maximum	Minimum
TobQ	442	2.17	0.851	4.86	1.74
CCADS	442	52.8	14.249	20.0	100.0
BVPS (\$)	442	0.37	0.183	2.04	0.06
EPS (\$)	442	0.02	0.035	0.28	0.01
IP	442	6.32	1.057	7.00	5.00
EcoSize (\$ billion)	442	175.86	13.906	448.1	32.2
MgtEff	442	0.14	0.035	0.175	0.11
Size (\$ million)	442	396.83	15.924	2182.47	85.18

The results show that the firms' average value (TobQ) was 2.17, indicating that the financial institutions have increased their book value by more than two times. This suggests that the financial institutions have increased the value of the shareholders in the capital market. Although the data demonstrate the incidence of outliers, the firms appeared to grow in value. The average score of the climate change accounting was 52.8%, suggesting more than half of the firms provided climate change information in their annual reports. The maximum and minimum scores of 100% and 20%, respectively, suggest that some firms provided full disclosures on their climate change activities while others provided minimal disclosures. The average book value per share (BVPS) of the firms was \$0.37, whereas the maximum and the minimum BVPS of the firms were \$0.54 and \$0.06, respectively. The results presented in Table 2 also show that the mean value of investor protection (IP) was 6.32, ranging from a minimum score of 5.00 to a maximum score of 7.00 and a low variability regarding the standard deviation. Concerning the countries' economic size (EcoSize), the results showed that the average EcoSize was \$175.86 billion, whereas the average size of the firms was \$396.83 million. Regarding the management efficiency (MgtEff) variable, the average score was 0.14, with maximum and minimum numbers being 0.175 and 0.11, respectively. This result suggests that some financial institutions were more efficient in using their assets to generate revenue than others.

The study further determined the level of correlation among the independent variables and their variance inflation factors, whose results are presented in Table 3. From Table 3, it could be observed that the correlations among the variables are not very strong to raise any multicollinearity concern. The result shows that the highest correlation coefficient was between ESP and BVPS, which was expected because the number of shares denominates both variables. However, the correlation coefficient between the other variables is less than 0.5, which is significantly less than the maximum benchmark of 0.75 accepted by researchers. These results emphasise that the data do not suffer from multicollinearity issues. This conclusion is supported by the VIF results, which are less than 5.0. These results are well below the VIF threshold of 10 embraced by other researchers. Based on these results, the study concludes that there is an absence of multicollinearity among the variables.

Table 3. Correlation matrix and Variance Inflation Factor (VIF)

	CCADS	BVPS	EPS	IP	EcoSize	MgtEff	Size	VIF
CCADS	1.000							4.92
BVPS	0.473***	1.000						2.76
EPS	0.085	0.562*	1.000					1.88
IP	0.268***	0.307	0.163*	1.000				3.01
EcoSize	-0.166	0.075	0.046	-0.327	1.000			4.57
MgtEff	0.092**	0.381	0.034**	0.141**	0.174*	1.000		1.53
Size	0.494***	-0.358	-0.139***	0.348	0.053**	0.312	1.000	2.84

Regression Results

Table 4 presents the results of the impact of climate change accounting on the value of financial institutions in West Africa. The table presents the results based on both fixed effect and random effect

Climate Change Accounting and Value Growth of Financial Institutions in West Africa

estimation techniques. However, the results further indicate that the Hausman test results are significant ($p < 0.05$), suggesting that the results according to the fixed effect technique are better. Based on this, the interpretation and discussions are done according to the results of the fixed effect estimation technique. The t-values are presented in parenthesis, whilst the asterisks denote the level of significance of the coefficients. Column 1 presents the results relating to the impact of climate change accounting on the value of financial institutions, whilst column 2 examines whether the strength of a country's investor protection influences the relationship between climate change accounting and firms' value.

Table 4. Regression results

	Panel Controlling Fixed Effects		Panel Controlling Random Effects	
	1	2	1	2
Intercept	3.1926*** (7.971)	2.7385 (6.205)	2.3803*** (4.135)	3.044** (5.187)
CCADS _{it}	.0571*** (5.827)	.0863** (2.019)	.0607*** (4.281)	.1488** (2.241)
BVPS _{it}	.0793* (1.833)	.1832 (1.286)	.0119 (1.075)	.0093 (1.138)
EPS _{it}	.0484*** (4.698)	.0792** (2.369)	.0692** (2.094)	.1037** (2.219)
IP _{it}	.1183* (1.851)	.1386* (1.861)	.1472 (1.193)	.2832** (1.983)
CADS*IP _{it}		.2018*** (5.981)		.3925 *** (4.649)
EcoSize _{it}	.0204 (1.091)	.0819 (1.149)	.1508 (1.148)	.0673* (1.794)
MgtEff _{it}	.1083*** (4.437)	.2106** (1.997)	.4776*** (4.851)	.2714*** (4.185)
Size _{it}	.0847** (2.016)	.14958* (1.794)	.1805** (2.085)	.3285** (1.974)
Observations	442	442	442	442
R-squared	79.63	84.71	81.29	80.13
Adjusted R-squared	72.97	77.48	76.02	72.81
F-statistics	273.12	124.93	189.16	82.12
Prob > F-statistics	0.000	0.000	0.000	0.000
Prob. of Hausman test	0.016	0.028	0.016	0.028

*** = Significant at 0.01; ** = Significant at 0.05 and * = Significant at 0.1

The results show that climate change accounting has a positive and significant ($p < 0.05$) relationship with the value of financial institutions in West Africa. This result implies that financial institutions that provide climate change information in their annual reports would enjoy value growth. This suggests that investors value climate change-related activities of financial institutions and demand that they disclose such information. The results further demonstrate that the book value per share (BVPS) of the firms have a positive and insignificant relationship with firms' value. This suggests that investors do not value the

historical value of a firm when they make an investment decision. On the other hand, the result shows that the firms' earnings per share (EPS) is positive and significantly related to firms' value. This result demonstrates that investors are concerned with the efficiency with which their investments are used to generate income. This result was expected because, apart from capital appreciation, investors are interested in the returns generated by their investment. Hence, they would stay away from firms that do not generate enough returns on their investment.

The results further show that investor protection has a positive but insignificant ($p > 0.05$) relationship with firms' value. Interestingly, in column 2, we find that the presence of a stronger investor protection significantly ($p < 0.01$) influences the relationship between climate change accounting and the value of the financial institutions. This result implies that the impact of climate change accounting on the value of firms is stronger in countries with regulations and policies that protect investors. In addition, the results show that management efficiency (MgtEff) had positive and significant impacts on firm value. This result suggests that management efficiency (MgtEff) is significant in explaining the value of the financial. The positive and significant relationship between MgtEff and the value of the financial institutions exists because efficient firms and their management can formulate good and effective strategies and policies to use their assets effectively to generate revenue and improve performance.

Similarly, the size of the economy (EcoSize) was positive and insignificant, suggesting that economic size may have had no impact on the value of the financial institutions. Concerning the firms' size, the result shows a positive and significant relationship with the firms' value. This result implies that firms with large asset size attract more investors, which increases their value. The results show that the R-square for model 1 and 2 are 79.63 and 84.71, respectively. These results suggest that the model's independent variables explain the variations in the dependent variable by up to 80%, which confirms that the models are robust and their related results are reliable.

DISCUSSION OF RESULTS

The evidence demonstrated a positive and significant relationship between climate change accounting and the value of financial institutions in West Africa. What this implies is that the performance of financial institutions would improve should they concentrate and improve their climate change disclosure activities. In addition, should the financial institutions increase their financing and investment on less environmental impact and climate-friendly projects, it will result in a positive performance and improve their value. This result is consistent with the legitimacy theory, which postulates that firms can improve their value if they provide information over and above the stakeholders' regulatory requirement. This suggests that as investors become more sophisticated, they become conscious of firms' various forms of information and their implications to firms' value. In this context, investors accept that climate change activities by financial institutions and their subsequent disclosures are significantly contributive to their future financial performance, stock prices; hence they incorporate such information in their decision making. An improvement in such information disclosure would mean that financial performance and firms' value would improve.

This result is surprising given that the activities of financial institutions do not directly have any negative impact on the environment. Based on this, it was expected that investors would not incorporate firms' climate activities and their disclosures in their valuation. However, the result suggests that investors and other stakeholders, particularly analysts, understand and value climate change reporting and

how it influences the financial sustainability of financial institutions. Therefore, analysts and investors can use climate change accounting for the future valuation of financial institutions. This incentivises financial institutions to incorporate climate change issues in their strategic goals and overall performance evaluation. This result further dispels that financial institutions should not be concerned about climate change activities because they have a little negative environmental impact. The evidence from this study is consistent with the findings of earlier studies such as those conducted by Schadewitz and Niskala (2010), Zamora-Ramirez and Gonzalez-Gonzalez (2015) and Qiu et al. (2016). These studies demonstrated that climate change accounting is valued by investors and other stakeholders of financial institutions; hence they incorporate them in their decision making. This result is also supported by Cahhan et al. (2016) and Bose et al. (2017) whose evidence showed a positive relationship between climate change or ESG accounting and banks' financial performance. On the other hand, the findings of this study contradict those of Marcia et al. (2015), Matuszak and Rozanska (2017) and Alsaifi et al. (2020), who documented a negative relationship between environmental/social/climate change accounting and firms' performance.

The findings also reveal that investors' valuation of climate change accounting is conditional to investors' level of protection of a country. The study finds that the impact of climate change accounting on the value of financial institutions is positively and significantly higher in countries with stronger investors protection. Moreover, the analysis of the interaction between management efficiency and firms' value shows that these variables are positively and significantly related. This result suggests that management or a firm's efficiency is one channel through which financial institutions can improve their value. This result supports the findings of Matuszak and Rozanska (2017) and the supposition that the performance of financial institutions could improve as they increase their efficiency. In addition, the post estimation results demonstrate that the model and its variables are robust.

The results further demonstrate that the book value per share (BVPS) of the firms have a positive and insignificant relationship with firms' value. This suggests that investors do not value the historical value of a firm when they make an investment decision. On the other hand, the result shows that the firms' earnings per share (EPS) is positive and significantly related to firms' value. This result demonstrates that investors are concerned with the efficiency with which their investments are used to generate income. This result was expected because, apart from capital appreciation, investors are interested in the returns generated by their investment. Hence, they would stay away from firms that do not generate enough returns on their investment.

The results further show that investor protection has a positive but insignificant relationship with firms' value. Interestingly, we found that the presence of a stronger investor protection significantly influences the relationship between climate change accounting and the value of the financial institutions. This result implies that the impact of climate change accounting on the value of firms is stronger in countries with regulations and policies that protect investors. In addition, the results show that management efficiency (MgtEff) had positive and significant impacts on firm value. This result suggests that management efficiency (MgtEff) is significant in explaining the value of the financial. The positive and significant relationship between MgtEff and the value of the financial institutions exists because efficient firms and their management can formulate good and effective strategies and policies to use their assets effectively to generate revenue and improve performance.

SUMMARY AND CONCLUSION

The study examined the impact of climate change accounting on the value of financial institutions in West Africa. Consistent with the legitimacy theory, the study found a positive and significant relationship between climate change accounting and the firms' value. This result implies that the firms' performance would improve should they concentrate and improve their climate change disclosure activities. This finding further demonstrates that climate change accounting is valued by investors and other stakeholders of financial institutions. The findings also revealed that the impact of climate change accounting on the value of financial institutions is positively and significantly higher in countries with stronger investors protection. Moreover, the interaction between management efficiency and firms' value demonstrated that management efficiency has a positive and significant relationship with the firms' value. This result suggests that management or firm efficiency is a channel through which the firms can improve their value.

These findings can expand our understanding of the process of generating value for investors in financial institutions and society, generally. These findings have implications for regulatory and policy development in the financial sector in West Africa. First, regulators and policymakers can establish an incentive structure to motivate financial institutions to embrace or integrate climate change issues and their accounting in their strategic objectives and business practices. This will ensure sustainable financial institutions in West Africa, especially as they move towards a single currency adoption. On the other hand, policymakers and regulators can incentivise the financial institutions to become pro-environment by penalising those that fail to embrace climate change friendly activities or refuse to report them through higher tax.

The study acknowledges the following limitations. First, only the listed financial institutions were considered. Hence, the case for non-listed financial institutions is unknown. In addition, the study was limited to financial institutions. It will be interesting to look at the other sectors, especially those with negative environmental impacts. Based on these limitations, this study recommends further studies to look into the value relevance of climate change accounting in non-listed financial institutions and firms operating in other sectors such as manufacturing and mining.

REFERENCES

- Abeysekera, I. (2013). A template for integrated reporting. *Journal of Intellectual Capital*, 14(2), 227–245. doi:10.1108/14691931311323869
- ACCA. (2013). *Improving natural capital reporting and finding the tools to help*. <https://www.accaglobal.com/content/dam/acca/global/PDF-technical/sustainabilityreporting/tech-tp-incr.pdf>
- Adegboyegun, A. E., Alade, M. E., Ben-Caleb, E., Ademola, A. O., Eluyela, D. F., & Oladipo, O. A. (2020). Integrated reporting and corporate performance in Nigeria: Evidence from the banking industry. *Cogent Business & Management*, 7(1), 1–12. doi:10.1080/23311975.2020.1736866
- Aggarwal, P., & Singh, A. K. (2019). CSR and sustainability reporting practices in India: An in-depth content analysis of top-listed companies. *Social Responsibility Journal*, 15(8), 1033–1053. doi:10.1108/SRJ-03-2018-0078

- Al-Dhaimesh, O. H., & Al Zobi, M. K. (2019). The effect of sustainability accounting disclosures on financial performance: An empirical study on the Jordanian banking sector. *Banks and Bank Systems*, 14(2), 1–8. doi:10.21511/bbs.14(2).2019.01
- Alsaifi, K., Elnahass, M., & Salama, A. (2020). Market responses to firms' voluntary carbon disclosure: Empirical evidence from the United Kingdom. *Journal of Cleaner Production*, 262, 1–11. doi:10.1016/j.jclepro.2020.121377
- Banghøj, J., & Plenborg, T. (2008). Value relevance of voluntary disclosure in the annual report. *Accounting and Finance*, 48(2), 159–180. doi:10.1111/j.1467-629X.2007.00240.x
- Bose, S., Saha, A., Khan, H. Z., & Islam, S. (2017). Non-financial disclosure and market-based firm performance: The initiation of financial inclusion. *Journal of Contemporary Accounting & Economics*, 13(3), 263–281. doi:10.1016/j.jcae.2017.09.006
- Buallay, A. (2019). Is sustainability reporting (ESG) associated with performance? Evidence from the European banking sector. *Management of Environmental Quality*, 30(1), 98–115. doi:10.1108/MEQ-12-2017-0149
- Busch, T., & Lewandowski, S. (2018). Corporate carbon and financial performance: A meta-analysis. *Journal of Industrial Ecology*, 22(4), 745–759. doi:10.1111/jiec.12591
- Cahan, S. F., de Villiers, C., Jeter, D. C., Naiker, V., & van Staden, C. J. (2016). Are CSR disclosures value relevant? Cross-country evidence. *European Accounting Review*, 25(3), 579–611. doi:10.1080/09638180.2015.1064009
- De Klerk, M., & De Villiers, C. (2012). The value relevance of corporate responsibility reporting: South African evidence. *Meditari Accountancy Research*, 20(1), 21–38. doi:10.1108/10222521211234200
- De Villiers, C., Hsiao, P.-C. K., & Maroun, W. (2017). Developing a conceptual model of influences around integrated reporting, new insights and directions for future research. *Meditari Accountancy Research*, 25(4), 450–460. doi:10.1108/MEDAR-07-2017-0183
- Esch, M., Schulze, M., & Wald, A. (2019). The dynamics of financial information and non-financial environmental, social and governance information in the strategic decision-making process. *Journal of Strategy and Management*, 12(3), 314–329. doi:10.1108/JSMA-05-2018-0043
- Evangelinos, K., Nikolaou, I., & Leal Filho, W. (2015). The effects of climate change policy on the business community: A corporate environmental accounting perspective. *Corporate Social Responsibility and Environmental Management*, 22(5), 257–270. doi:10.1002/csr.1342
- Gulluscio, C., Puntillo, P., Luciani, V., & Huisingh, D. (2020). Climate Change Accounting and Reporting: A Systematic Literature Review. *Sustainability*, 12(13), 54–55. doi:10.3390/s12135455
- Horvat, R. & Korošec, B. (2015). The Role of Accounting in a Society: Only a technological solution for the problem of economic measurement or also a tool of social ideology? *Našegospodarstvo/Our Economy*, 61(4), 32-40.

- Kılıç, M., & Kuzey, C. (2019). The effect of corporate governance on carbon emission disclosures. *International Journal of Climate Change Strategies and Management*, 11(1), 35–53. doi:10.1108/IJCCSM-07-2017-0144
- Lozo, S. (2019). *Nothing but the truth? Climate risk disclosure by US companies*. Harvard University Extension School ENVR S-599 Independent Research Capstone.
- Marcia, A., Maroun, W., & Callaghan, C. (2015). Value relevance and corporate responsibility in the South African context: An alternate view post King-III'. *Suid-Afrikaanse Tydskrif vir Ekonomiese en Bestuurswetenskappe*, 18(4), 500–519. doi:10.4102ajems.v18i4.1192
- Masuma, M. H., Hassanb, N., & Jahana, T. (2019). Corporate climate change reporting: Evidence from Bangladesh. *Accounting and Management Information Systems*, 18(3), 399–416. doi:10.24818/jamis.2019.03005
- Matuszak, Ł., & Róžańska, E. (2017). An examination of the relationship between CSR disclosure and financial performance: The case of Polish banks. *Accounting and Management Information Systems*, 16(4), 522–533. doi:10.24818/jamis.2017.04005
- Mousa, G., & Hassan, N. T. (2015). Legitimacy theory and environmental practices: Short notes. *International Journal of Business and Statistical Analysis*, 2(01).
- Murray, A., Sinclair, D., Power, D., & Gray, R. (2006). Do financial markets care about social and environmental disclosure? Further evidence and exploration from the UK. *Accounting, Auditing & Accountability Journal*, 19(2), 228–255. doi:10.1108/09513570610656105
- Ohlson, J. A. (1995). Earnings, Book Values, and Dividends in Equity Valuation. *Contemporary Accounting Research*, 11(2), 661–687. doi:10.1111/j.1911-3846.1995.tb00461.x
- Pellegrino, C., & Lodhia, S. (2012). Climate change accounting and the Australian mining industry: Exploring the links between corporate disclosure and the generation of legitimacy. *Journal of Cleaner Production*, 36, 68–82. doi:10.1016/j.jclepro.2012.02.022
- Qiu, Y., Shaukat, A., & Tharyan, R. (2016). Environmental and social disclosures: Link with corporate financial performance. *The British Accounting Review*, 48(1), 102–116. doi:10.1016/j.bar.2014.10.007
- Schadewitz, H., & Niskala, M. (2010). Communication via responsibility reporting and its effect on firm value in Finland. *Corporate Social Responsibility and Environmental Management*, 17(2), 96–106. doi:10.1002/csr.234
- Sief, H. S. (2014). Accounting Framework to Measure the Environmental Costs and Disclosed in Industrials Companies-Case Study of Societe Cement Hamma Bouziane (SCHB) in Constantine. *The China Business Review*, 13(6), 356–366.
- Solikhah, B., Yulianto, A., & Suryarini, T. (2020). March. Legitimacy Theory Perspective on the Quality of Carbon Emission Disclosure: Case Study on Manufacturing Companies in Indonesia Stock Exchange. IOP Conference Series: Earth and Environmental Science, 1(1), 12-63.

Climate Change Accounting and Value Growth of Financial Institutions in West Africa

Task Force on Climate-Related Financial Disclosures. (2017). *Final report: Recommendations of the Task Force on Climate-related Financial Disclosures*. Retrieved 12/01/2021, from <https://assets.bbhub.io/company/sites/60/2020/10/FINAL-2017-TCFD-Report-11052018.pdf>

Thistlethwaite, J. (2015). The politics of experimentation in climate change risk reporting: The emergence of the Climate Disclosure Standards Board (CDSB). *Environmental Politics*, 24(6), 970–990. doi:10.1080/09644016.2015.1051325

Vitolla, F., Raimo, N., & Rubino, M. (2019). Appreciations, criticisms, determinants, and effects of integrated reporting: A systematic literature review. *Corporate Social Responsibility and Environmental Management*, 26(2), 518–528. doi:10.1002/csr.1734

Zamora-Ramirez, C., & Gonzalez-Gonzalez, J. M. (2015). The Value of Climate Change Reporting of Firms: The Spanish Case. *International Journal of Social Ecology and Sustainable Development*, 6(4), 90–103. doi:10.4018/IJSESD.2015100107

Zhao, C., Guo, Y., Yuan, J., Wu, M., Li, D., Zhou, Y., & Kang, J. (2018). ESG and corporate financial performance: Empirical evidence from China's listed power generation companies. *Sustainability*, 10(8), 1–18. doi:10.3390/s10082607

Chapter 27

The Impact of Climate Change on Global Entrepreneurial Activities

Mkhothi Tshabalala

University of KwaZulu-Natal, South Africa

Andrisha Beharry Ramraj

University of KwaZulu-Natal, South Africa

Jayrusha Ramasamy-Gurayah

University of KwaZulu-Natal, South Africa

ABSTRACT

In this era of climate change, there has been urgent calls for entrepreneurs to adopt sustainable business practices. Entrepreneurs need to seek to increase their production efficiency. Entrepreneurs have looked at sustainability as a solution to improve value for society, the environment, and financial gains for their businesses. Businesses around the globe are embracing entrepreneurial business sustainability with the aim of increasing their triple bottom line. Climate change has challenged not only governments across the world but also businesses. Businesses around the globe are embracing entrepreneurial business sustainability with the aim of increasing their triple bottom line. Climate change has challenged not only governments across the world but also businesses, and as a result, efforts have been made by various stakeholders such as the United Nations to assist countries in mitigating the consequences of climate change on economic, social, and ecological dimensions.

INTRODUCTION

International bureaucracies such as the United Nations (UN) have been encouraging the need for entrepreneurs and corporates to introduce green or rather clean methods and systems of production that will have minimal or no harm towards the environment. This led to the development of the concept

DOI: 10.4018/978-1-7998-7967-1.ch027

The Impact of Climate Change on Global Entrepreneurial Activities

“sustainable development” by the UN in the Brundtland Report in 1987 (Klarin, 2018). The concept of “sustainable development” in its basic meaning implies economic development that meets the present needs of the current generation without compromising the ability of the future generation to also fulfill their needs (Klarin, 2018).

Therefore, this chapter intends to investigate the extent to which global entrepreneurial activities are affected by climate change. There are efforts and initiatives undertaken by governments and international organisations to mitigate the consequences of climate change. For example, the UN introduced seventeen (17) goals to be met in order to ensure sustainable development. These efforts by the UN are to protect people and the environment from harmful industrial production activities which further lead to climate change (Figueres, Schellnhuber, Whiteman, Rockström, Hobley and Rahmstorf, 2017).

Thus, scholars (Scott, Hall & Gössling, 2016; Matsumoto, Hasegawa, Morita, & Fujimori, 2019; Hoegh-Guldberg, Jacob, Taylor, Bolaños, Bindi, Brown, Camilloni, Diedhiou, Djalante, Ebi, & Engelbrecht, 2019) argued that businesses should also play their part in ensuring sustainability by adopting or utilising a cleaner energy source such as solar energy in their production processes. However, the above-mentioned scholars’ emphasis rather encourages entrepreneurial initiatives that seek to introduce environmentally friendly resources. Therefore, the gap in literature is that scholars have focused their studies on large corporates, and this chapter intends to add sustainability-related literature aimed at small entrepreneurial enterprises.

Moreover, the identified problem in literature is that scholars such as De Coning (2018) and Chassé (2017) among others have only discussed the consequences of corporates’ negligence towards the environment and the world at large. This chapter intends to discuss a different perspective, which is how entrepreneurial businesses can contribute to sustainability and which initiatives can be adopted to achieve efficiency.

BACKGROUND

First and foremost, it is important to note that the impact of climate change on global entrepreneurial activities has been researched by different scholars including the likes of Kraus Burtcher, Vallaster, and Angerer (2018), Sarango-Lalangui, Santos, and Hormiga (2018) and Rashid (2019). Therefore, the reason why this topic has gained attention over the years, is due to the fact that constantly rising industrial activities continue enabling climate change, for example the introduction of fast cars that release high carbon emission, and large corporates relying heavily on natural resources such as coal for energy generation has raised global climate concerns.

Moreover, the UN (2016) mentioned that entrepreneurs alongside businesses can play a vital role not only in addressing worldwide ecological challenges but also by helping to eradicate poverty and hunger, build peaceful societies and protect the environment (Apostolopoulos, Al-Dajani, Holt, Jones, & Newbery, 2018). Furthermore, the World Economic Forum (2020) noted that in order for the world to achieve sustainability, collaboration of entrepreneurs is essential simply because entrepreneurs are the drivers of innovation. As a result of enabling entrepreneurs from across the world to work together, the world can get cleaner inventions.

Thus, the UN has initiated entrepreneurial programmes such as the E4 Impact Foundation that is aimed at providing African entrepreneurs, particularly youth and children, with the platform to explore entrepreneurship through talking to successful entrepreneurs from across the world. Such initiatives

are conducted to encourage entrepreneurship, as it potentially addresses all the social, economic and environmental issues that currently face the African continent (United Nations, 2016). Furthermore, the UN (2016) mentioned that it is essential to encourage sustainable entrepreneurship through incentives.

In addition, South Africa like other African countries faces severe social, economic and ecological challenges. Thus, the government has established initiatives such as the New Growth Path, National Development and National Skills Development Strategy, which are targeted at encouraging and incentivising sustainable entrepreneurial activities or rather businesses. Hence, sustainable entrepreneurship can contribute significantly towards achieving the sustainable development goals, given the fact that South Africa is a signatory to achieving sustainable development goals (Marks & Hidden, 2017).

CLIMATE CHANGE

The National Aeronautics and Space Administration (NASA), (2014) defined climate change as changes in natural weather conditions found in a place, for example this could be the change in rain levels in a place leading to floods. It is also the change in the earth's temperatures, which are heat levels beyond the earth's normal levels. National Geographic (2019) further added that climate change results in weather patterns that are unpredictable and as a result the agricultural sector gets affected the most, hence, maintaining, and growing crops is difficult when expected temperatures and rains are less predictable and at some point rains are even scarce in summer.

Climate change is also connected to extreme or rather damaging weather events that threaten the safety of humans' and animals' lives. These events include but are not limited to intense floods, hurricanes and winter storms (National Geographic, 2019). Furthermore, climate change also threatens the sustainability of the earth's ecological system, hence, climate change results in global warming which is the rise of global temperatures caused by the increasing greenhouse gases in the atmosphere, and for such reasons climate change has led to the development of the "sustainability" concept (Youmatter, 2020).

Wetts (2020) argued that climate change is mainly caused by human and corporate activities which include but are not limited to burning of fossil fuels (natural gases, coal and oil). Burning of these natural gases releases what is already mentioned above as "greenhouse gases". Over the years corporates have been the major contributors to climate change - the emissions that come from their large factories, vehicles and power plants that generate power for corporates. Also, the major source of greenhouse gases is the production of disposable paper and baby care products (Axelrod, 2019).

Thus, Azarkamand and Darbra Roman (2020) argued that international organisations such as the World Meteorological Organization (WMO) and United Nations Environment (UNE) had to set up an Intergovernmental Panel on Climate Change (IPCC). The objective of the panel was to provide more clarity about the impact of entrepreneurial or rather corporate and human activities towards the environment from a global perspective. Hence, it is essential to note that when corporates and people overlook the consequences of climate change, the entire world will be compromising the lives of the current and future generations.

THE SEVENTEEN (17) SUSTAINABLE DEVELOPMENT GOALS

Zeng (2020) argued that the constantly rising concerns over environmental degradation caused by industrial and entrepreneurial activities has led to one hundred and ninety-three countries (193) signing and committing themselves to achieving the seventeen (17) sustainable development goals for 2030. Moreover, these goals are aimed at mitigating economic activities that contribute to climate change and further preserve earth resources for future generations. Moyer and Hedden (2020) mentioned that the sustainable development goals also contribute towards poverty eradication, education and adequate health care.

Therefore, the first sustainable development goal is to end poverty in countries around the world and permanently terminate all forms of poverty in countries. Zhu & Shek (2020) argued that ensuring the social well-being of those living in extreme poverty is critical towards securing a better future for all. However, COVID-19 crisis has decelerated the progress towards poverty eradication. The second goal is zero hunger, which is much associated with the 'poverty eradication goal' however it prioritises food security for all, improved nutrition and encourages sustainable agriculture (Naidoo, 2020).

The third sustainable goal is good health and well-being; the primary motive of this goal is to ensure and promote healthy lives across citizens in different countries regardless of age, more especially in times like COVID-19 which challenges and endangers the lives of citizens globally (Naidoo, 2020).

The fourth goal is quality education which is aimed at promoting equal education for all while mitigating differences in the quality of education. This goal also promotes educational inclusivity of all individuals in different countries. Thus, Zhu & Shek. (2020) argued that lifelong learning opportunities should be availed to all.

The fifth sustainable development goal is gender equality. This goal intends to encourage the participation and inclusion of women and girls in economic activities that previously were dominated by males, such as the manufacturing and agricultural sectors (Moyer & Hedden, 2020).

The sixth goal is to secure clean water and sanitation. This goal is primarily driven by the supply of clean water and sanitation to rural communities. In such parts of the world drinkable water and sanitation are still inaccessible which compromises the livelihood of the people (Zeng, 2020).

The seventh sustainable development goal is affordable and clean energy, which pushes for all countries, specifically poor countries, to have accessible energy such as electricity, which is made available to all citizens. The goal is to also achieve reliable electricity more especially in sub-Saharan Africa (Tsalis, Malamateniou, Koulouriotis, & Nikolaou, 2020).

The eighth goal is decent work and economic growth. This goal intends to encourage a sustained economic growth in countries across the world while promoting decent working conditions and employment for all (Eisenmenger, Pichler, Krenmayr, Noll, Plank, Schalmann & Gingrich, 2020).

The ninth sustainable development goal is industry, innovation and infrastructure. Naidoo (2020) mentioned that this goal seeks to encourage countries to adopt and build modernised infrastructure that facilitates faster production and convenience into citizens' lives in order to enable innovation. The goal also promotes industrialisation as this reduces the unemployment rate in a given country.

The tenth goal is to reduce inequalities among and within countries; this starts with reducing the uneven distribution of wealth in countries and then eliminating policies that benefit the rich countries at the cost of the poor (van Zanten & van Tulder, 2020).

The eleventh sustainable development goal is sustainable cities and communities. The goal aims to push for cities that are more safe and human settlements that are inclusive, sustainable and resilient (Zeng, 2020).

The twelfth goal is responsible consumption and production which ensures that countries implement restrictions and tariffs to encourage clean production and consumption patterns.

The thirteenth goal is climate action, and this goal is aimed at encouraging countries to develop policies that will help combat activities that lead to climate change such as industrial pollution (Seto-Pamies & Papaoikonomou, 2020).

The fourteenth sustainable development goal is life below water, which basically refers to better and sustainable utilisation of the ocean and ensuring sustainable development by conserving sea and marine resources.

The fifteenth goal is life on earth which refers to the protection, restoration and promotion of a sustainable use of the ecosystem, specifically terrestrial.

The sixteenth goal is peace, justice and strong institutions. The goal intends to ensure communities that are fair for all with emphasis on inclusivity and accountability by institutions being the drivers to achieve peaceful societies.

The seventeenth goal is partnership for goals, which refers to securing the means to strengthen the cooperation of countries to achieve the sustainable development goals at a global level (Bali Swain, & Yang-Wallentin, 2020).

THE IMPACT OF CLIMATE CHANGE ON THE TRIPLE BOTTOM LINE

In entrepreneurship, the triple bottom line refers to three pillars known as the three Ps, namely *People, Planet and Profits*, to ensure sustainable development across countries and the world at large. The three pillars serve as the basis for sustainability of which entrepreneurs and corporates should align their operations and activities to equally benefit the triple bottom line (Westerman, Rao, Vanka & Gupta, 2020). Neri, Cagno, Lepri and Trianni (2020) also argued that the existence of the triple bottom line is to restrict entrepreneurial and corporate activities that contribute towards climate change. Hence, climate change directly affects the aspects of the triple bottom line.

- **Economic Pillar**

The economic pillar of the triple bottom line refers to the ability of the economy to maintain sustainable economic growth over the years and this is achieved through investment in research and development initiatives to develop cleaner production methods. Moreover, economic sustainability is achieved through encouraging entrepreneurs and corporates to pursue sustainable initiatives (Gu, Wang, Hua & Zhongdil., 2020). However, Alsawafi (2020) argued that economic growth in African countries is restricted by Africa's dependence on agricultural or rather natural resources which poses a challenge for Africa to maintain sustained growth.

Therefore, the impact of climate change on the economic pillar of the triple bottom line starts from the abnormal weather conditions such as heavy rains and wind which damage the country's infrastructure such as ports and roads (Paterson, 2020). Nyambuu et al. (2020) also mentioned that the damage of infrastructure disrupts economic activities such as exporting and importing of goods, transportation of goods and production facilities. Furthermore, climate change propels entrepreneurs and corporates to adopt innovations that are resistant towards extreme weather conditions (Paterson, 2020).

The Impact of Climate Change on Global Entrepreneurial Activities

- **Environmental Pillar**

The environmental pillar of the triple bottom line refers to means by entrepreneurs and corporates within a country and the world at large to maintain equilibrium between the use of natural resources and the available natural resources (Wit et al., 2020). The environmental pillar serves to protect the interests of the planet from harmful entrepreneurial and corporate activities, the protection also extends to activities by humans in general (Gu et al., 2020). Thus, Wit and Pylak (2020) argued that countries that heavily depend on natural resources to gain economic growth are the worst hit by environmental restrictions and higher tariffs.

Furthermore, Gallego-Schmid, Chen, Sharmina, and Mendoza (2020) mentioned that climate change poses several threats to the environment especially towards biodiversity, which includes changes in phenology, inland water, which is the availability of water on the planet accessible by people, hence climate change disrupts rainfall pattern. Gardner (2020) also argued that climate change affects the marine environment due to increases in sea surface temperatures, abnormal shifts in wind patterns and ocean acidifications which affects calcium carbonate-secreting organisms. In addition, extreme floods damage arable lands.

- **Social Pillar**

The social pillar of the triple bottom line refers to the social dimensions of the society which include but are not limited to education, access to health care resources and the overall well-being of the people (quality of life) (Sala, 2020). The social pillar of the triple bottom line seeks to reduce unemployment rates within countries and the world at large, equal participation of female and males in economic development, poverty alleviation and ensures an improved standard of living for communities (Danielsen & Agnarsson, 2020). Thus, corporates and entrepreneurs are obliged to give back to societies that support them.

Moreover, Neri et al. (2020) explained the concept of climate change injustice, which refers to those communities or individuals worst affected by climate change events and can barely recover from such events. One of the major contributors to the inability to recover is the lack of social support such as available jobs, social grant reliefs and adequate health care facilities. Hence, Liu, Chu, Anderson and Xu (2020) argued that extreme weather such as floods damage homes and abnormal heat temperatures lead to heat rash, sunburn and heat stroke which affect the livelihoods of people.

THE IMPACT OF CLIMATE CHANGE ON GLOBAL ECONOMIC ACTIVITIES

Matsumoto (2018) argued that climate change is the result of human socio-economic activities, particularly burning of fossil fuels, which then affects the environment and overall economic activities. Thus, the extent to which climate change affects economic activities is, for example, extreme rains or rather floods which raise sea levels above maximum and then affect land areas that are arable. Water surface runoff damages crops and then the entire food supply chain is disrupted. Consequently, agricultural productivity is affected as a result of extreme weather conditions.

Also, climate change does not only threaten the agricultural sector, but also affects labour productivity, especially employees working outdoors. Xia, Li, Guan, Tinoco, Xia, Yan, Yang, Liu, and Huo (2018) argued that heat-induced stress leads to declining labour productivity, and abnormal heat temperatures

further threaten human health. Li, Chow, Zhu and Lin (2016) also mentioned that the declining labour productivity as a result of hot weather temperatures affected the economic activities as labourers cannot work at a fast pace in hot weather, and thus this leads to economic production loss and delays.

Furthermore, Mouratiadou, Biewald, Pehl, Bonsch, Baumstark, Klein, Popp, Luderer and Kriegler (2018) argued that drought resulting from climate change and water shortages plays a significant role in the functionality of economies, for example water is the key input in most energy generation or production and conversion processes. The electricity sector needs fresh water in cooling generated electricity. Thus, when countries suffer from severe droughts the power generation industry suffers the most and as a result electricity companies fail to meet the industrial electricity demand which then affects the efficiency and productivity of large and small corporations.

In addition, Ogbua (2017) argued that climate change has compelled countries throughout the world to adopt high technology and mechanised agricultural systems to continue with productivity in the adversity of climate change. However, poor economies, particularly in Africa, lack climate change adaptation capacity, for example fast reactive or warning systems that will notify entrepreneurs or corporates about extreme weather that is looming. Thus, African economies are the worst affected by climate change because their economic activities are natural resource sensitive and there is failure to adopt higher technology.

GLOBAL ENTREPRENEURIAL ACTIVITIES

According to the Global Entrepreneurship Monitor (2018), entrepreneurs are involved in global activities for various reasons, but mainly to acquire resources and skills that are not available in their home countries and to explore or rather reach out to a larger market. Furthermore, Coviello and Jones (2014) argued that global entrepreneurial activities constitute or rather combine risk-seeking, innovative and proactive behaviour that goes beyond national borders as is aimed at creating or adding value to the entrepreneur's organisation. Thus, these entrepreneurial activities lead to cross-cultural collaboration between entrepreneurs.

Global entrepreneurial activities include exporting and importing of goods and services to and from the global market. This is simply because there are specific resources only available in certain countries (Soto-Acosta, Del Giudice & Scuotto., 2018), for example the African continent is well endowed in natural resources, specifically minerals, therefore, entrepreneurs such as Patrice Motsepe export minerals to the global market (Forbes, 2017). Also, global entrepreneurs' activities include sourcing of goods and services from abroad because of competitive prices in the global market compared to the home country (Acosta et al., 2018).

Andrenelli, Lejarraga, Miroudot and Montinari (2019) argued that entrepreneurs form strategic partnerships and ventures with other entrepreneurs across the world; such initiatives are undertaken in order to share or rather exchange technologies and sales network, among other reasons. Also, entrepreneurs associate their start-ups with well-known international brands or corporates to gain recognition and be able to penetrate global markets, for example entrepreneurs such as Alexander Wang from America teamed up with a well-known Swedish company H&M to add his fashion range in H&M stores globally (Forbes, 2014).

In addition, entrepreneurs that have successful businesses in home countries branch out and open stores in different countries and/or have subsidiaries across the world. Entrepreneurs do this by building facilities, and once the business operates in the foreign country it acts and is treated like other domestic

The Impact of Climate Change on Global Entrepreneurial Activities

businesses. Entrepreneurs pursue such initiatives to benefit from lower taxes, cheap labour and other privileges in foreign countries, such as advanced technologies. Moreover, entrepreneurs opening branches in foreign countries also benefits the host country (Andrenelli et al., 2019).

IMPACT OF CLIMATE CHANGE ON GLOBAL ENTREPRENEURIAL ACTIVITIES

Crecente (2020) argued that climate change consequences extend to or rather affect international activities, particularly multinational enterprises, and entrepreneurs in various ways, which then leads to a decline in global entrepreneurial activities. Hence, climate change has led to the development of stricter policies towards global entrepreneurial activities such as opening a branch in foreign countries. However, the policies developed by countries also vouch for sustainable entrepreneurial activities, for example the European Entrepreneurial Region Project rewards sustainable entrepreneurial activities.

Furthermore, Porter, Reay, Higgins and Bomberg (2016) mentioned that climate change directly affects the food supply chains, especially ones that are agriculturally related. Thus, entrepreneurs that export or import food from and to foreign countries are the worst hit by climate change simply because when their home countries suffer extreme weather such as severe droughts, then productivity becomes stagnated which then means in that particular year entrepreneurs within the agricultural sector cannot participate in any global food supply chain. This thus minimises global entrepreneurial activities in that particular year.

In addition, climate changes have encouraged or rather influenced the development of policy frameworks that impose harsh penalties on entrepreneurial activities which threaten or compromise sustainable development (Mintrom, 2017). A suitable sighted example; the Intergovernmental Panel on Climate Change Report (2018) suggested policy frameworks that must be adopted by countries to ensure entrepreneurs adhere to measures that seek to mitigate greenhouse gases caused by businesses. European countries therefore impose higher taxes and tariffs on foreign businesses that intend to operate in their countries (Mintrom, 2017).

Entrepreneurs also face external pressures from international organisations that are concerned about climate change as a result of carbon emissions, greenhouse gases and overall industrial pollution, for example the pressure comes from initiatives such as The Paris Agreement (Lee & Ahn, 2019). Therefore, global entrepreneurial initiatives such as erecting a plant in foreign countries is prohibited by the above-mentioned environmental initiatives because Embry, Jones and York (2019) mentioned that it is believed that large plants are energy intensive and produce higher pollution.

THE MAJOR EFFECT OF CLIMATE CHANGE ON GLOBAL ENTREPRENEURIAL ACTIVITIES

Bayer, Pinkerton and Urpelainen (2015) reported that governments across the world, namely Lithuania, United States of America and Kenya, are among countries with the strictest environmental laws. What this does for global entrepreneurial activities is that entrepreneurs must make necessary applications for permits to conduct their operations in global markets (foreign countries). Mentioned permits include the Title V Permit under the Clean Air Act (Bayer et al., 2015).

Thus, further Narváez, Riscanevo and Guzmán (2018) stated that applications for permits to operate in foreign countries take longer to be processed and approved, hence the business activities must be thoroughly reviewed by different law authorities. While entrepreneurs wait for permits to be granted, their intended international activities remain stagnated, which further leads to a decline of global entrepreneurial activities. Narváez et al. (2018) also mentioned that the process of acquiring the permit is facilitated by lawyers who help entrepreneurs to decipher the information of the business.

Moreover, Sanders (2019) argued that higher tariffs and environmental laws discourage global entrepreneurial activities, simply because tariffs raise the costs of doing business in or rather with countries with higher tariffs. For example, when a country has higher tariffs as a measure to discourage entrepreneurial activities that might comprise sustainable development, global entrepreneurial activities such as exporting and importing of goods and services decline, as entrepreneurs try to avoid import and export-associated costs.

MAJOR CHANGES CLIMATE CHANGE HAS BROUGHT TO GLOBAL ENTREPRENEURIAL ACTIVITIES

Heiret (2020) mentioned that climate change has led to changes in resource availability and costs. Hillman et al. (2020) stated that extreme weather conditions in countries such as Japan, Philippines and Ruanda have disrupted food supply chains. Therefore, entrepreneurs from the above-mentioned countries cannot participate in global food supply chains.

Moreover, according to Hillman and Baydoun (2020), climate change has led to a change in demand, hence as the global temperatures rise throughout different seasons, the demand for goods that are usually demanded in winter declines and entrepreneurs that supply different countries with winter-related goods are the most affected. Also, consumers globally are prioritising sustainable or rather eco-friendly products, therefore consumers' tastes and preferences shift towards products and enterprises that promote or sell eco-friendly goods. Thus, entrepreneurs' entrepreneurial activities that threaten sustainability are sidelined.

Therefore, the identified changes in food supply chains that result from climate change consequences threaten global food security, simply because the projected increase in heat temperatures, extreme weather events and changes in precipitation patterns lead to reduced global agricultural activities. Thus, global entrepreneurial activities such as exporting and importing food from different countries remain stagnated in the events of extreme weather conditions that prohibit agricultural activities (Gaugler, Stoeckl & Rathgeber, 2020).

MAJOR CHALLENGES FACING GLOBAL ENTREPRENEURIAL ACTIVITIES

Dhahri and Omri (2018) argued that it has become difficult for entrepreneurs to sustain their global entrepreneurial activities. Firstly, it is noted that countries throughout the world require entrepreneurs to be socially responsible as much as possible and as a result global entrepreneurs must have different business models for different countries. For example, a case study on global entrepreneurship in climate change conditions by de Block et al. (2019) revealed that countries across the world use different criteria to assess the entrepreneurs' social responsibility.

The Impact of Climate Change on Global Entrepreneurial Activities

Thus, a business model that is deemed eco-friendly or adheres to sustainability standards in South Africa might be rejected in countries that have high standards and consideration of sustainable development such as Lithuania. Therefore, when entrepreneurs conduct their global entrepreneurial activities, the first thing they must consider is to determine the sustainability standards and requirements of each country and design or rather reshape their business model to best meet sustainability requirements of different foreign countries. However, tailoring a business model for each country can be costly (de Block, Feindt, & van Slobbe, 2019).

Dall’Aglia, Hayati and Lee (2020) noted that social responsibility initiatives affect large corporates and entrepreneurs differently, for example corporate social responsibility is a beneficial initiative for large corporates because it boosts the image of the organisation and further attracts potential investors. Most importantly large corporates have enough funds to finance or rather contribute to sustainable development initiatives. On the other hand entrepreneurs who own small businesses have a hard time financing social sustainability initiatives which then means meeting social responsibility in other countries becomes a challenge and forces entrepreneurs to quit their global entrepreneurial initiatives.

MEASURES GLOBAL ENTREPRENEURS ADOPTED TO PROTECT THEIR GLOBAL ACTIVITIES AGAINST REPERCUSSIONS OF CLIMATE CHANGE

Ghalwash (2017) established that entrepreneurs across the world have begun adopting eco-friendly production methods and systems such as utilising solar for power generation instead of electricity, recyclable products and also donations to international organisations that seek to address the negative impact of climate change on the environment and global supply chains.

Entrepreneurs from the agricultural sector have also adopted modern farming techniques such as hydroponic farming, which is the fourth industrial method of farming. Briefly, the hydroponic farming technique is the type of farming that does not use soil to plant and grow crops. Farmers use nutrient-rich water and other supporting material such as perlite, vermiculite and peat moss (Veriticalroots, 2020). Entrepreneurs have adopted such farming techniques to mitigate the negative impact of climate change on the quality of the soil which has led to a decline in arable land.

In addition, Moon, Walmsley and Apostolopoulos (2018) argued that there are ‘climate opportunistic entrepreneurs’ who started their entrepreneurship initiatives to pursue opportunities presented by climate change. Examples of such initiatives include renewable energy products, recyclable products and overall eco-friendly business models (online sales) and solar systems. Therefore, entrepreneurs within such sectors thrive in the global market simply because international organisations (UN Paris Agreement, UN Intergovernmental Panel on CI) encourage countries to support and endorse sustainable entrepreneurship initiatives.

RECOMMENDATIONS

Scholars such as Dutta and Banerjee (2018), Moskwa, Higgins-Desbiolles and Gifford (2015) and Ratten and Dana (2018) mentioned that entrepreneurs must focus primarily on sustainable-related entrepreneurial initiatives in order to thrive not only on a national but also an international level. A perfect example of this is the drought-tolerant lentil variety discovered by Bangladeshi entrepreneurs. Entrepreneurs can

also build their business models around sustainable systems and methods such as utilising solar power to power the business or the production unit of the organisation (Terziev, 2016).

Furthermore, Lee et al. (2016) argued that the major obstacle behind the failure of global entrepreneurial activities is the lack of innovation. The UN and The International Renewable Energy Agency continuously encourage countries to promote entrepreneurial initiatives that are sustainable in order to achieve the 2030 Sustainable Development Agenda. Entrepreneurs need to introduce innovative products and services that contribute towards sustainable development in order to achieve support and endorsement from various countries.

Moreover, governments in different countries have established platforms and designed policy frameworks that incentivise and support sustainable entrepreneurial initiatives, for example in South Africa there are government initiatives such as The Small Enterprise Development Agency, The Industrial Policy Action Plan and The National Development Plan. Therefore, entrepreneurs can use the above-mentioned government initiatives to enhance their sustainability initiatives and grow, and as a result it will become easy for entrepreneurial activities to thrive globally (PwC, South Africa, 2019).

Also, the National Academies of Sciences, Engineering and Medicine (2017) mentioned that entrepreneurs can escape the impact of climate change on their global entrepreneurial activities by simply modifying their business models. The technological advancements have provided entrepreneurs worldwide with the opportunity to enhance their initiatives in various ways, for example within the food or rather the agricultural sector at large entrepreneurs can switch to biotechnology systems instead of traditional ways of growing crops.

In addition, Manab and Aziz (2019) argued that entrepreneurs must protect their global entrepreneurial activities from climate change repercussions by designing or implementing integrated planning. This means entrepreneurs need to recognise the need to incorporate climate change consequences in their activities and therefore draw up a plan on how to better prepare their organisations against climate change. This can include adopting systems that will alert the organisation of anticipated unusual weather conditions and also setting a budget for climate-related risks.

FUTURE RESEARCH

The focus and objectives of this chapter was to understand the impact of climate change on global entrepreneurial activities. On that account, future research can be carried out on a similar research topic however focusing on the impact of climate change on entrepreneurial activities from a specific country or continent, as the impact of climate change differs from country to country and continent to continent. This will help narrow down the impact of climate change on entrepreneurial activities to a local context.

CONCLUSION

The purpose of this chapter was to investigate the extent to which climate change affects global entrepreneurial activities and then provide practical solutions to the problem which are the recommendations gathered from different scholars. However, what was discovered is that international and well as recognised organisations pressurise countries to mitigate or remove all economic activities that compromise sustainable development, and in that process, global activities of entrepreneurs are the most affected.

The Impact of Climate Change on Global Entrepreneurial Activities

Also, climate change has forced entrepreneurs to redesign their business models in order to remain competitive on the global market. Also, what the researchers discovered is that the available literature on global entrepreneurship focuses primarily on limited fields such as telecommunication, renewable energy and environmental tax in foreign countries. Future research on this topic should focus on the role that can be played by the industrial revolution in shifting businesses from using or burning fossil fuels, among other harmful business activities, to adopting cleaner systems and technologies to mitigate climate change consequences.

REFERENCES

- Alsawafi, A., Lemke, F., & Yang, Y. (2020). The impacts of internal quality management relations on the triple bottom line: A dynamic capability perspective. *International Journal of Production Economics*, 232, 107927. doi:10.1016/j.ijpe.2020.107927
- Andrenelli, A., Lejárraga, I., Miroudot, S., & Montinari, L. (2019). *Micro-Evidence on Corporate Relationships in Global Value Chains: The Role of Trade*. FDI and Strategic Partnerships.
- Apostolopoulos, N., Al-Dajani, H., Holt, D., Jones, P., & Newbery, R. (2018). *Entrepreneurship and the sustainable development goals*. Emerald Publishing Limited. doi:10.1108/S2040-724620188
- Axelrod, J. (2019). *Corporate Honesty and Climate Change: Time to Own Up and Act*. Available at: <https://www.nrdc.org/experts/josh-axelrod/corporate-honesty-and-climate-change-time-own-and-act>
- Azarkamand, S. & Darbra Roman, R.M. (2020). *Climate change and carbon footprint initiatives*. Academic Press.
- Bali Swain, R., & Yang-Wallentin, F. (2020). Achieving sustainable development goals: Predicaments and strategies. *International Journal of Sustainable Development and World Ecology*, 27(2), 96–106. doi:10.1080/13504509.2019.1692316
- Bayer, P., Pinkerton, V. M., & Urpelainen, J. (2015). Small and beautiful? The Programme of Activities and the least developed countries. *Climate and Development*, 7(2), 153–164. doi:10.1080/17565529.2014.900471
- Chassé, S., & Boiral, O. (2017). Legitimizing corporate (un) sustainability: A case study of passive SMEs. *Organization & Environment*, 30(4), 324–345. doi:10.1177/1086026616672065
- Coviello, N. E., & Jones, M. V. (2014). Methodological issues in international entrepreneurship research. *Journal of Business Venturing*, 19(4), 485–508. doi:10.1016/j.jbusvent.2003.06.001
- Crecente, F., Sarabia, M., & del Val, M. T. (2020). Climate change policy and entrepreneurial opportunities. *Technological Forecasting and Social Change*.
- Dall’Aglia, C., Hayati, F., & Lee, D. (2020). *Measuring the Biases*. Burdens, and Barriers Women Entrepreneurs Endure in Myanmar.
- Danielsen, R., & Agnarsson, S. (2020). In Pursuit of the Three Pillars of Sustainability in Fisheries: A Faroese Case Study. *Marine Resource Economics*, 35(2), 177–193. doi:10.1086/708245

de Block, D., Feindt, P. H., & van Slobbe, E. (2019). Shaping conditions for entrepreneurship in climate change adaptation. *Ecology and Society*, *24*(1), art19. doi:10.5751/ES-10310-240119

De Coning, C. (2018). *Sustaining Peace: Can a new approach change the UN?* Academic Press.

Deloitte. (2019). *Feeling the heat? Companies are under pressure to act on climate change and need to do more.* <https://www2.deloitte.com/us/en/insights/topics/strategy/impact-and-opportunities-of-climate-change-on-business.html>

Dhahri, S., & Omri, A. (2018). Entrepreneurship contribution to the three pillars of sustainable development: What does the evidence really say? *World Development*, *106*, 64–77. doi:10.1016/j.worlddev.2018.01.008

Dutta, A., & Banerjee, S. (2018). Does microfinance impede sustainable entrepreneurial initiatives among women borrowers? Evidence from rural Bangladesh. *Journal of Rural Studies*, *60*, 70–81. doi:10.1016/j.jrurstud.2018.03.007

Eisenmenger, N., Pichler, M., Krenmayr, N., Noll, D., Plank, B., Schalmann, E., & Gingrich, S. (2020). The Sustainable Development Goals prioritize economic growth over sustainable resource use: A critical reflection on the SDGs from a socio-ecological perspective. *Sustainability Science*, *15*(4), 1101–1110. doi:10.1007/11625-020-00813-x

Embry, E., Jones, J., & York, J. G. (2019). Climate change and entrepreneurship. In *Handbook of Inclusive Innovation*. Edward Elgar Publishing. doi:10.4337/9781786436016.00032

Figueres, C., Schellnhuber, H. J., Whiteman, G., Rockström, J., Hobley, A., & Rahmstorf, S. (2017). Three years to safeguard our climate. *NATNews*, *546*(7660), 593. PMID:28661507

Forbes. (2014). *11 Of The Best Strategic Brand Partnerships In 2014*. Available at: <https://www.forbes.com/sites/michellegreenwald/2014/12/11/11-of-the-bestsmaestmost-interesting-strategic-brand-partnerships-of-2014>

Gallego-Schmid, A., Chen, H. M., Sharmina, M., & Mendoza, J. M. F. (2020). Links between circular economy and climate change mitigation in the built environment. *Journal of Cleaner Production*, *260*, 121115. doi:10.1016/j.jclepro.2020.121115

Gardner, A. L. (2020). Climate Change and the Environment. In *Stars with Stripes* (pp. 379-421). Palgrave Macmillan. doi:10.1007/978-3-030-29966-8_11

Gast, J., Gundolf, K., & Cesinger, B. (2017). Doing business in a green way: A systematic review of the ecological sustainability entrepreneurship literature and future research directions. *Journal of Cleaner Production*, *147*, 44–56. doi:10.1016/j.jclepro.2017.01.065

Gaugler, T., Stoeckl, S., & Rathgeber, A. W. (2020). Global climate impacts of agriculture: A meta-regression analysis of food production. *Journal of Cleaner Production*, *276*, 122575. doi:10.1016/j.jclepro.2020.122575

Ghalwash, S., Tolba, A., & Ismail, A. (2017). What motivates social entrepreneurs to start social ventures? *Social Enterprise Journal*.

The Impact of Climate Change on Global Entrepreneurial Activities

Gu, Wang, Hua, & Liu. (n.d.). Entrepreneurship and high-quality economic development: Based on the triple bottom line of sustainable development. *International Entrepreneurship and Management Journal*, 1–27.

Heiret, T. (2020). *The Impact of Climate Change Induced Resource Scarcity on Human Security: An Analysis of Experiences by Families in Lokichoggio, Turkana County, Kenya* (Doctoral dissertation). United States International University-Africa.

Hillman, J. R., & Baydoun, E. (2020). An Overview of Innovation and Entrepreneurship to Address Climate Change. In *Higher Education in the Arab World* (pp. 141–181). Springer. doi:10.1007/978-3-030-37834-9_6

Hoegh-Guldberg, O., Jacob, D., Taylor, M., Bolaños, T. G., Bindi, M., Brown, S., Camilloni, I. A., Diedhiou, A., Djalante, R., Ebi, K., & Engelbrecht, F. (2019). The human imperative of stabilizing global climate change at 1.5 C. *Science*, 365(6459), eaaw6974. doi:10.1126/science.aaw6974 PMID:31604209

Klarin, T. (2018). The concept of sustainable development: From its beginning to the contemporary issues. *Zagreb International Review of Economics and Business*, 21(1), 67–94. doi:10.2478/zireb-2018-0005

Kraus, S., Burtscher, J., Vallaster, C., & Angerer, M. (2018). Sustainable entrepreneurship orientation: A reflection on status-quo research on factors facilitating responsible managerial practices. *Sustainability*, 10(2), 444. doi:10.3390/s10020444

Lee, B. X., Kjaerulf, F., Turner, S., Cohen, L., Donnelly, P. D., Muggah, R., Davis, R., Realini, A., Kieselbach, B., MacGregor, L. S., Waller, I., Gordon, R., Moloney-Kitts, M., Lee, G., & Gilligan, J. (2016). Transforming our world: Implementing the 2030 agenda through sustainable development goal indicators. *Journal of Public Health Policy*, 37(1), 13–31. doi:10.1057/41271-016-0002-7 PMID:27638240

Lee, S. Y., & Ahn, Y. H. (2019). Climate-entrepreneurship in response to climate change. *International Journal of Climate Change Strategies and Management*, 11(2), 235–253. doi:10.1108/IJCCSM-09-2017-0177

Li, X., Chow, K. H., Zhu, Y., & Lin, Y. (2016). Evaluating the impacts of high-temperature outdoor working environments on construction labor productivity in China: A case study of rebar workers. *Building and Environment*, 95, 42–52. doi:10.1016/j.buildenv.2015.09.005

Liu, L., Chu, J., Anderson, J. L., & Xu, J. (2020). Sustainability comparisons in the triple bottom line for Chinese fisheries. *Marine Policy*, 104259.

Manab, N., & Aziz, N. (2019). Integrating knowledge management in sustainability risk management practices for company survival. *Management Science Letters*, 9(4), 585–594. doi:10.5267/j.msl.2019.1.004

Marks, J., & Hidden, K. (2017). *SMMEs and the Green Economy: Muddy waters and murky futures. An investigation into the sustainable practices of small medium and micro manufacturing enterprises in South Africa's Gauteng Province*. JP Morgan and Gordon Institute of Business Science.

Matsumoto, K. I. (2018). Climate change impacts on socioeconomic activities through labor productivity changes considering interactions between socioeconomic and climate systems. *Journal of Cleaner Production*, 216, 528–541. doi:10.1016/j.jclepro.2018.12.127

- Matsumoto, K. I., Hasegawa, T., Morita, K., & Fujimori, S. O. (2019). Synergy potential between climate change mitigation and forest conservation policies in the Indonesian forest sector: Implications for achieving multiple sustainable development objectives. *Sustainability Science*, 14(6), 1657–1672. doi:10.1007/11625-018-0650-6
- Mintrom, M., & Luetjens, J. (2017). Policy entrepreneurs and problem framing: The case of climate change. *Environment and Planning C. Politics and Space*, 35(8), 1362–1377.
- Moon, C.J., Walmsley, A. & Apostolopoulos, N. (2018). Governance implications of the UN higher education sustainability initiative. *Corporate Governance: The International Journal of Business in Society*.
- Moskwa, E., Higgins-Desbiolles, F., & Gifford, S. (2015). Sustainability through food and conversation: The role of an entrepreneurial restaurateur in fostering engagement with sustainable development issues. *Journal of Sustainable Tourism*, 23(1), 126–14. doi:10.1080/09669582.2014.940046
- Mouratiadou, I., Biewald, A., Pehl, M., Bonsch, M., Baumstark, L., Klein, D., Popp, A., Luderer, G., & Kriegler, E. (2016). The impact of climate change mitigation on water demand for energy and food: An integrated analysis based on the Shared Socioeconomic Pathways. *Environmental Science & Policy*, 64, 48–58. doi:10.1016/j.envsci.2016.06.007
- Moyer, J. D., & Hedden, S. (2020). Are we on the right path to achieve the sustainable development goals? *World Development*, 127, 104749. doi:10.1016/j.worlddev.2019.104749
- Naidoo, R. & Fisher, B. (2020). *Reset sustainable development goals for a pandemic world*. Academic Press.
- Narváez, A. P., Riscanevo, K. A., & Guzmán, M. A. (2018). Environmental licenses. *Tékhné (Instituto Politécnico do Cávado e do Ave)*, 15(2), 23–38.
- NASA. (2014). *What Is Climate Change?* Available at: <https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-climate-change-k4.html>
- National Academies of Sciences, Engineering and Medicine. (2017). *Preparing for future products of biotechnology*. National Academies Press.
- National Geographic. (2019). *Climate Change*. Available at: <https://www.nationalgeographic.org/encyclopedia/climate-change/>
- Neri, A., Cagno, E., Lepri, M., & Trianni, A. (2020). *A triple bottom line balanced set of Key Performance Indicators to measure the sustainability performance of industrial supply chains*. Sustainable Production and Consumption.
- Ogbuabor, J.E. (2017). *The impact of climate change on the Nigerian economy*. Academic Press.
- Paterson, M. (2020). Climate change and international political economy: Between collapse and transformation. *Review of International Political Economy*, 1–12. doi:10.1080/09692290.2020.1830829
- Porter, S. D., Reay, D. S., Higgins, P., & Bomberg, E. (2016). A half-century of production-phase greenhouse gas emissions from food loss & waste in the global food supply chain. *The Science of the Total Environment*, 571, 721–729. doi:10.1016/j.scitotenv.2016.07.041 PMID:27432722

The Impact of Climate Change on Global Entrepreneurial Activities

Rashid, L. (2019). Entrepreneurship Education and Sustainable Development Goals: A literature Review and a Closer Look at Fragile States and Technology-Enabled Approaches. *Sustainability*, *11*(19), 5343. doi:10.3390/u11195343

Ratten, V., & Dana, L. P. (2017). Sustainable entrepreneurship, family farms and the dairy industry. *International Journal of Social Ecology and Sustainable Development*, *8*(3), 114–129. doi:10.4018/IJSESD.2017070108

Sala, S. (2020). Triple bottom line, sustainability and sustainability assessment, an overview. *Biofuels for a More Sustainable Future*, 47-72.

Sanders, M. (2019). *The Disadvantages of Tarrifs & Quotas*. Available at: <https://smallbusiness.chron.com/disadvantages-tarrifs-quotas-20726.html>

Sarango-Lalangui, P., Santos, J. L. S., & Hormiga, E. (2018). The development of sustainable entrepreneurship research field. *Sustainability*, *10*(6), 2005. doi:10.3390/u10062005

Scott, D., Hall, C. M., & Gössling, S. (2016). A report on the Paris Climate Change Agreement and its implications for tourism: Why we will always have Paris. *Journal of Sustainable Tourism*, *24*(7), 933–948. doi:10.1080/09669582.2016.1187623

Seto-Pamies, D. & Papaoikonomou, E. (2020). *Sustainable development goals: A powerful framework for embedding ethics, CSR, and sustainability in management education*. Academic Press.

Soto-Acosta, P., Del Giudice, M., & Scuotto, V. (2018). Emerging issues on business innovation ecosystems: The role of information and communication technologies (ICTs) for knowledge management (KM) and innovation within and among enterprises. *Baltic Journal of Management*, *13*(3), 298–302. doi:10.1108/BJM-07-2018-398

Terziev, V. (2016). Entrepreneurship in organic production—an incentive for sustainable rural development. *Agricultural and Resource Economics: International Scientific E-Journal*, *2*(4).

Tsalis, T. A., Malamateniou, K. E., Koulouriotis, D., & Nikolaou, I. E. (2020). New challenges for corporate sustainability reporting: United Nations' 2030 Agenda for sustainable development and the sustainable development goals. *Corporate Social Responsibility and Environmental Management*, *27*(4), 1617–1629. doi:10.1002/csr.1910

United Nations. (2016). *Women and Youth Entrepreneurship in Africa*. Available at: <https://www.un.org/en/africa/osaa/pdf/events/20160613/entrepreneurship-conceptnote.pdf>

van Zanten, J. A., & van Tulder, R. (2020). Towards nexus-based governance: Defining interactions between economic activities and Sustainable Development Goals (SDGs). *International Journal of Sustainable Development and World Ecology*, 1–17.

Verticalroots. (2020). *The What and Why of Hydroponic Farming*. Available at: <https://www.verticalroots.com/the-what-and-why-of-hydroponic-farming/>

Westerman, Rao, Vanka, & Gupta. (2020). Sustainable human resource management and the triple bottom line: Multi-stakeholder strategies, concepts, and engagement. *Human Resource Management Review*, *30*(3).

Wetts, R. (2020). In climate news, statements from large businesses and opponents of climate action receive heightened visibility. *Proceedings of the National Academy of Sciences of the United States of America*, *117*(32), 19054–19060.

Wit, B., & Pylak, K. (2020). Implementation of triple bottom line to a business model canvas in reverse logistics. *Electronic Markets*, *30*(4), 1–19. doi:10.1007/12525-020-00422-7

World Economic Forum. (2020). *How businesses can build a sustainable future for all*. Available at: <https://www.weforum.org/agenda/2020/09/how-businesses-build-sustainable-future/>

Xia, Y., Li, Y., Guan, D., Tinoco, D. M., Xia, J., Yan, Z., Yang, J., Liu, Q., & Huo, H. (2017). Assessment of the economic impacts of heat waves: A case study of Nanjing, China. *Journal of Cleaner Production*. Advance online publication. doi:10.1016/j.jclepro.2017.10.069

Youmatter. (2020). *Climate Change: Meaning, Definition, Causes, Examples And Consequences*. Available at: <https://youmatter.world/en/definition/climate-change-meaning-definition-causes-and-consequences/>

Zeng, Y., Maxwell, S., Runting, R. K., Venter, O., Watson, J. E., & Carrasco, L. R. (2020). Environmental destruction not avoided with the Sustainable Development Goals. *Nature Sustainability*, *3*(10), 795–798. doi:10.1038/41893-020-0555-0

Zhu, X., & Shek, D. T. L. (2020). Predictive Effect of Positive Youth Development Attributes on Delinquency Among Adolescents in Mainland China. *Frontiers in Psychology*, *11*, 615900. doi:10.3389/fpsyg.2020.615900 PMID:33381073

Chapter 28

Effect of Climate Change on the Manufacturing Sector

Zwelihle Wiseman Nzuza

Durban University of Technology, South Africa

ABSTRACT

The challenge of climate change in the world has hitherto perplexed scholars and professionals, with reports of climate change not sparing the manufacturing sector. All countries are most vulnerable to this threat and will suffer greatly if no action is taken. In the 21st century, scientists have confirmed with great concern the severe weather conditions that are expected to become harsher. The aim of the chapter is to explore the effect of climate change on the manufacturing sector. Literature has been used as a source of secondary data. The effect of climate is examined from five major business strategic positions: productivity, business risk, goods and services, chemicals and minerals, natural resources, and buildings. The chapter also covers the need for manufactures to adapt to climate change with various possible actions that can be taken by the sector against climate impacts on business. Continuous staff and management training and education on climate change is recommended.

INTRODUCTION

Concerns about climate change have been rising significantly over the past decade, and recently, the top five long term risks mentioned by the World Economic Forum's Global Risks Report are all in the environmental circle. With every key signs pointing to a bad condition getting worse (Drzik, 2020). Factoring climate change into the business equation is not common practice in the manufacturing sector, yet it is expected to produce goods and services and present these for human consumption. The impact of climate change on the manufacturing sector in today is something that cannot be disputed. According to the Kenya private sector alliance (2014), the world manufacturing sector is largely comprised of agro processing. Production includes paper production, textile and apparels, pharmaceutical and medical equipment, as well as building construction, and chemical-related industries (Ridoutt, Sanguansri, Bonney, Crimp, Lewis, and Lim-Camacho, 2016). Unreliable power generation and supply in most parts of the world is the reason most manufacturing industries make use of emergency power systems. This

DOI: 10.4018/978-1-7998-7967-1.ch028

is evidence that the 21st century manufacturing sector has completely transformed from its traditional routine to a modern energy setup. Should no actions be taken to mitigate the impact of climate change, this study believes that manufactures will cease to operate.

The growing unreliability of power generation and supply calls for researchers to begin experimenting with the idea of allowing climate change to slowly aid in increasing productivity. The well-known 21st century scientist, Stephen Hawkins, predicted that climate change has the potential to collapse the entire world. However, regardless of several scientific hypotheses, there is a notable lack of awareness and misconstructions that have made it difficult for businesses to adequately respond to the trial (Crutzen, 2000). This is confirmed by Nabegu and Ali (2016), who state that the subject of change in climate has, to date, been discussed and investigated mainly by the scholarly society and very little has been shared to communities. While climate change has taken its toll and affected businesses, there have been gaps in addressing the effect of climate change in the manufacturing sector and it is without doubt that there remains scope for improvement in this field. This chapter discusses the role and impact of climate change in the manufacturing sector. In fact, the extreme weather conditions we are experiencing require our maximum attention as these are expected to increase (Nabegu and Ali, 2016).

BACKGROUND

Today is not the first time carbon dioxide and other greenhouse gas levels in the atmosphere have been extraordinary (Mann and Kump, 2012). Changes in the climate have been occurring for many years with the exception of the 19th century being the period that scholars started to see it as a potential research area. In the mid to-late 1980s it first emerged on the public agenda beyond the scientific society (Seacrest, Kuzelka, and Leonard, 2000). Climate change has been prevalent throughout industries, with erratic patterns that are hard to predict (Nabegu and Ali, 2016). According to Muhammad (2012), climate change signifies to long term variation in the statistical distribution of weather patterns over decades to thousands years of time. The change in climate is attributed to various factors, including the immense production of greenhouse gases and unjustifiable misuse of natural resources, while in the oceans, social activities have reformed the global climate pushing land structure beyond natural capacity, with changes in the atmosphere and other forms of living things (Nabegu and Ali, 2016). United nations framework convention on climate change (2012) defined climate change as “*a change of climate which is attributed directly or indirectly to human activity...*”. However, Muhammad (2012) definition of climate change includes *change due to natural variability alongside human activity*. Australian government (United nations framework convention on climate change, 2011) describes climate change as “*a change due to the observed escalations in human produced greenhouse gases that absorb heat from the sun in the atmosphere and reduce the amount of heat escaping into space*”. This superfluous heat is observed to be the major source of variations in the climate system. In general, the term ‘climate change’ through various definitions, qualifies as a pollution originating in human activity. Likewise, Mann and Kump (2012) agree that changes in the climate have been mainly the result of human activities and this is a ninety-five percent certainty according to the Intergovernmental Panel on Climate Change (IPCC), an organization which was established in 1988 to address intergovernmental issues on climate change. Having had to classify what climate change is in general, it is equally important to define it within the manufacturing sector. This definition is significant because manufacturing represents nearly 20% of domestic direct emissions, and it is indirectly accountable for an extra 11% of emissions through electricity use by households (Nabegu

Effect of Climate Change on the Manufacturing Sector

and Ali, 2016). Hoyt and Schatter (1997) define the term climate change in the manufacturing sector as it refers to an unpredictable numerical description of weather that influences the production of goods and services. Climate change remains the leading challenge in the manufacturing sector but it has not become the industry standard for regulatory decisions based on the overhead costs (Kenya private sector alliance, 2014). As a result, the industrial revolution intended a shift from human intensive to capital intensive, and launched the era of ignition engines with the automobile hence the extreme burning of fossil fuels. This did not work in any way as the burning of fossil fuels discharges pollutants comprising greenhouse gases. Similarly, human activities have released great amounts of heat holding greenhouse gases into the atmosphere, which in turn makes the land surface and sea temperature to rise.

EFFECT OF CLIMATE CHANGE ON THE MANUFACTURING SECTOR

It is important to understand that climate is more than just a few warm or cool days; it refers to typical weather events in the entire region over an extended time, such as 30 years or more. Therefore, keeping an eye on changing weather can assist manufacturers to plan ahead. The effect of climate change is evident in all manufacturing sectors, including both labour intensive and capital intensive operations. Labour intensive refers to industries that involve a great amount of labour to produce their goods and services, whereas capital intensive uses long-life, fixed assets to produce goods and services. In the following section, the effects of climate change in the manufacturing sector are covered.

Climate Change Affects Productivity

Productivity is a fraction of volume of inputs versus the volume of outputs. It measures how proficiently production inputs, such as assets and labour, are being used in an economical manner. Dobrinevski and Jachnik (2020) found that industries that employ fixed assets in the process of production suffer significantly from water shortages, which are adversely impacted by extreme climate changes. When a large proportion of electrical energy is generated by hydropower and there is severe climate change, this has a negative impact on productivity. Mitchell (2017) confirms that the manufacturing sector is one of the major victims of reduced power generation capacity because of reduced rainfall leading to droughts.

A study conducted by Curphey (2019) from Europe provides three specific industries that are intensely affected by climate change:

1. **Insurance** - the insurance industry will have to compensate other sectors for the damage occurring.
2. **Tourism** – fear of tourists to travel due to severe weather conditions in divers' places has been reported.
3. **Food production and beverage industry** - this industry is reported to run short of food availability and beverage industry also likely to runoff of pure water.

Another report by Thomson Reuters (2015) presents six more other industries from Canada that are feeling the pinch of climate. These are:

1. **Agriculture** - droughts, extreme heat and storms cause crops to be wiped out.
2. **Energy** - floods lead to power outages.

3. **Transportation** - downpours, higher temperatures, drought and sea levels affect infrastructure hence transportation.
4. **Mining** – Drought limit the water supply needed for mining and increase dust emissions, which are pricey to manage.
5. **Construction** – severe weather destroys the buildings and other infrastructure.
6. **Manufacturing** - weather affects the supply, production and transportation of goods.

The cost element as an economic factor is not spelled out from the list of effects of climate change on the manufacturing sector. For example, as temperatures rise, (Ackerman and Stanton, 2017) upper demand for air-conditioning and refrigeration in United States is expected to escalate energy costs to more than \$140 billion, as many manufactures that do not have these facilities will have to purchase them. Other impact areas such as water, real estate and hurricane damages are assigned over \$1 trillion, \$600 billion and \$800 billion budgets respectively. As reported by Environmental Affairs Department, (Ackerman and Stanton, 2017) a developing country like South Africa is also taking part to fight against climate change. For 2019/20, 2020/21 and 2021/22 the country allocated more than R7 million, close to R8 million and nearly R9 million budgets respectively to deal with climate change. This shows that many economic models have attempted to accommodate the cost of climate change.

It is for these reasons that governments propose to turn to technologies other than oil and gas methane emissions including coal as sources of energy, which lead to increased air pollution (United Nations Asian and Pacific Training Centre for Information and Communication Technology for Development, 2013). Technology has a potential to offer great environmental advantages, generating more power by mass than other fossil fuel or hydrocarbon including coal and gasoline refined from oil, while generating significantly less carbon dioxide and other chemicals that add to pollution and corrupt air (Dobrinevski and Jachnik, 2020). This is supported by the World Economic Forum (MethaneSAT, 2019) that is pushing to get the fastest and robust solutions to climate change by developing a satellite mission called ‘MethaneSAT’, which is designed to map and measure methane emissions from global oil and gas operations, a strategy to reduce global oil and gas methane emissions at 45% by 2025 and eventually at 100% by 2050 almost every place on the planet. It should also be noted that productivity can be affected by heat-related factors, leading to extensive financial loss, specifically in countries where most of the gross domestic product comes from manufacturing. Kenya private sector alliance (2014) adds that climate conditions also influence labour. For example, when the weather is cold, people work more productively than when it is hot. This is an indicator that changes in temperature may result in increased incidences of labour experiencing skin diseases, strokes, and dehydration, leading to increased manufacturing overhead costs. Moreover, should no action be taken, the number of climate related deaths around the world will rise. The death of employees leads to the loss of a skilled workforce that could have been utilized to improve productivity. The manufacturing sector operates with limited natural resources and this is expected to become more so with climate change. Furthermore, climate change additionally has the potential to reduce crop production in the manufacturing sector. Accordingly, when considering productivity, the priorities such as food security, water security and energy security are important.

Manufacturing Sector at Business Risk From Climate Change

Climate change increases an extra layer of intricacy that needs to be well thought out in corporate strategy hence a detailed understanding of climate risks in the manufacturing sector remains unusual (Europa,

Effect of Climate Change on the Manufacturing Sector

2019). Berkhout, Hertin and Gann (2006) are of the opinion that for some manufacturing sectors, indicators involving climate change impacts may be ambiguous and the benefits of strategic actions may be uncertain. Nevertheless, Dhanai, Negi, Singh, and Parmar (2014) disclose that most manufactures are facing a continual changing environmental landscape that they must traverse. The modern business risks caused by climate change are discussed below:

Staff Turnover

Manufacturing services in other parts of the world might be subjected to snowstorms and floods that make it difficult for assets and employees to get to work. For instance, in severe temperate zones, storms can cause damage to infrastructure making it difficult for staff work (Europa, 2019). Found that climate change has a direct effect on staff attitudes and, in turn, their turnover. Gregory and Angelina (2006) confirm that business climate includes staff perceptions and their effective reaction to the work tasks and workplace characteristics. Ehrhart and Kuenzi (2017) proposed a research model that suggests that the higher the satisfaction with organizational climate, the higher the employees work passion. Europa (2019) ascertains that 70% to 80% of business re-engineering and total quality management initiatives have failed in the past due to negligence and undervaluing the relationship between climate and employees. Europa (2019) and Morrell, Loan-Clarke and Wilkinson (2004) found that more manufactures are diverting to remote working and modern technologies as means of operation. Therefore, there is no doubt that a great number of employees will lose jobs due to retrenchments or lack of skills (Goni and Budiarmo, 2018; Gordon, 1998).

Loss of Revenue

According to Wyman (2020), climate change improves non value adding costs in the organization. These costs may include depreciation expenses for stationary assets (these include plants, equipment and vehicles) that have been left static due to interim remote working and use of technologies to counterpart climate disorders. The need for low carbon transition is creating demand for new business strategies that require more funds (Harvard gazette, 2019). Products that do not meet climate requirements will be in lesser market demand and ultimately reduce revenue (Wyman, 2020). A study by Yu and Xinpeng (2019) conforms a positive relationship between the impact of climate change and business revenue.

High Insurance Premium

Another notable risk revealed by Mitchell (2017) lies with increased insurance premiums due to higher costs related to more frequent extreme weather conditions. In fact, insurers response to climate change considers to address their business risks and achieve greater resilience. As a result, insurers turn to allocate more funds to mitigate climate hits by improving assessment of climate risk using modern softwares and working with policy holders and policy makers to lighten climate risk impacts (Deloitte, 2019). Europa (2019) reports that wildfires are also becoming a risk to the manufacturing sector. In actual fact, there is no manufacturing that can be considered wildfire proof, irrespective of location. Therefore, there is a great need of improved asset management for manufactures.

Asset Depreciation Risk

Asset depreciation risk is also known as asset quality risk, and is associated with losses of asset useful life that may occur as a result of climate disaster on business operating assets (Gambarelli, 2020). Researches from the African countries explore climate change links to asset adaptation (Frayne, Moser and Ziervogel, 2012). Fixed assets such as plants, equipment, buildings, vehicles and land operate in a dynamic environment where they are visible to short, medium and long term climate variability (Rayner, 2010). Gambarelli (2020) categorizes asset depreciation risk as “*a physical business risk that is directly related to climate change impacts, such as a flood destroying a production plant or climate variability affecting crop production*”. Folk (2018) predicts more events that will interrupt the operations of industries and cause them great financial and physical damages.

Changing Regulations

New regulations intended to address and prevent climate pollution have significantly impacted industries and continue to do so, and most of these regulations are received from the desk of government to mitigate pollution (Folk, 2018). As a result, a substantial investment into upgrading facilities to reduce and capture emissions has been done (Ackerman and Stanton, 2017). Energy industries, of course, are at present working to modify their power generation processes to comply with new regulations (Folk, 2018). Yildiz and Şeren (2020) propose a multi-dimensional policy instead of a one-dimensional policy that will address environmental issues including cognizant society and national, and cooperation of policy actors on a universal scale. Ghazouani, Xia, Jebli and Shahzad (2020) believe that one critical way to cut carbon emissions, is placing a tax on every ton of greenhouse gas emitted. The Congressional Budget Office (Yildiz and Şeren, 2020) projects that with a tax of \$25 per metric ton of CO₂, emissions would be more than 10% in 2028. It is for this reason that more than forty (40) states around the world have already implemented a carbon tax on industries. South Africa is reported to have above 80% of basic energy powered by coal, with new regulations needed to reduce emissions at above 35% by 2035 (National treasury, 2018). It is worth noting that changing the regulations to address climate challenges is not an easy task, as it requires the political will, leadership, and public support. All of these participants would need to know first, what a carbon tax is and does, why it is significant, and where the carbon tax changed is going in (Ghazouani, Xia, Jebli and Shahzad, 2020).

Climate Change Damages Sensitive Goods and Services

The goods and service industries have been recognized as some of the businesses where climate change has been harsh (Linnenluecke, Griffiths and Winn, 2013). Ridoutt et al (2016) also testifies that the rising temperatures have caused winds and storms, which affected transportation of food and services including port operations. Most food processors rest strongly on water, either as a necessity for the hygienic operation of their facilities or as an ingredient, and water provisions have the latent to be squeezed critically by climate conditions. It is clear that climate changes are likely to lead to destruction of sensitive goods and services, mainly those dependent on either temperature or water. Distinct care is needed when storing certain products that have to stay at a fairly constant temperature before use. Sensitive products may include but are not limited to medical items, wine, ice cream, and fresh fruit, as well as meats. Wine is also a sensitive item as, the hotter you store it, the faster it will age and the more it ages, the flatter

Effect of Climate Change on the Manufacturing Sector

the flavor. Manufactures that produce wine products have to ensure these are stored under a favorable temperature. Other fragile products such as ice cream, fresh fruits, and meats obviously need to stay under freezing point at all times. When these products are exposed to temperatures above freezing, they melt and deteriorate in quality.

Climate Change Damages Chemicals and Minerals

Chemical industry is mostly recognized as being responsible for the rapidly rising temperatures globally and is by far the leading industrial user of energy of approximately 10% of the global energy demand (Pye, 2016). Europa (2019) reports that the energy demand of the chemical sector exceeds the demand of mineral production and basic metal fabrication combined. Concerning the medical goods production, Insulated products corp (2015) reveals that due to a warm weather condition, certain medical goods are kept at closed room temperatures of between 64 to 73°C. Likewise, an item that necessitates a low-cooled temperature must be stored at 5°C within the 2 to 8°C range or lower, or risk a shrink in value. Most importantly, what needs be considered is that chemical and mineral industries can also be impacted by their own pollution. With innovation scientific advances in biology and agriculture that are now happening, these are providing smooth transitions for these industries to bio-based renewable chemicals that have reduced environmental consequences (Pye, 2016).

Climate Change Damages Natural Resources

There is a commendable evidence from literature that supports a claim that climate change is allergic to natural resources. Chemical industries association (2015) is one of the esteemed observers of the effect of climate on natural resources who found that the trees are also sensitive to climate change and scientists can research the state of the climate decades ago by means of reviewing the inside of trees that have been alive since then. Great lakes integrated sciences assessment (2009) reveals that the impact of climate change on natural resources vary extensively based on people, animals and other factors. For example, with increasing CO₂, forest productivity is expected to increase until other factors present further stressors to natural resources. Water shortages also occur in divers' places which puts the manufacturing sector at water supply risk. Storms and high winds are not spelled out from the equation that affect the sector and the services on which it relies. Thus the sector needs to assess its risk to this hazard by checking if any areas could be vulnerable to strong winds and explore the potential for storms in the current and future climates of relevant locations.

Climate Change Damages Buildings

Buildings are recognized as business assets and are held for various purposes in the manufacturing sector with some used for production and others for administration purposes (Price water house coopers, 2010). Most of these buildings are unadventurous in design and many of them are fabricated from concrete or brick, both of which are high energy materials. The production of cement which is used to make concrete and brick is a high temperature course which involves the direct production of carbon dioxide to the atmosphere (Mitchell, 2017). Commercial and dwelling buildings combined account for around 35% of the final energy use and some close to 10% gigatonnes of carbon dioxide equivalent (Mitchell, G. R. (2017; Pye, 2016). Though buildings contribute to climate change, according to Dhanai et al (2014),

there are buildings that are vulnerable to surface water flooding. Camilleri, Jaques and Isaacs (2001) note that heavy downpours in winters make it even more difficult to direct rainwater and meltwater away from buildings including paved areas and roads. Pye (2016) a warmer climate creates groundwater which damages the land and reduces durability of buildings. Higher water levels in streams courses greater risk of storm flows along the coastline, which makes it imperative to safeguard buildings against leakage and flooding. Streletskiy, Suter, Shiklomanov, Porfiriev, and Eliseev (2019) are of the opinion that in the future there may be a surge in the risk of building collapse, snow damage, water encroachment, and people's health. Therefore, this chapter has provided sound recommendations of how manufactures need to deal with the impact of climate change and this follows after the Paris climate conference in December 2015 where about 200 countries agreed to the global first universal action plan to deal with climate changes (Mitchell, 2017).

POSITIONING THE MANUFACTURING SECTOR AGAINST CLIMATE CHANGE

Leaders in Sustainable Manufacturing

Manufacturers need to consider climate change as an opportunity for business growth. An alternative strategy would be to change the manner in which some products are manufactured, such as design by function rather than design by form, which is the conventional method. Another option is direct digital manufacturing and design by function rather than by form (Mitchell, 2017). They can also, for instance, consider to withdraw from using coal as a reliable and cheap source of electricity, as this will lead to worsen the climate situation. Re-engineering process and product design can also lead to a more efficient use of resources, better recycling and less environmental pollution.

Adapt Manufacturing to Climate Change

Adjusting to climate change is subject to the nature and location of the manufacturing facilities and consists of ensuring business infrastructure can cope with severe climate changes, integrating climate impacts in strategic planning and resolution, and assessing current and future climate risks to advance planning and decision-making. Some of the strategies to adapt manufacturing to climate change are listed below:

- Efficiently use of material by re-using materials and products and recycling. The design of new products should also support, reuse and recovery programmes. This can be achieved by giving more consideration on waste reduction followed by re-use, recycling and energy recovery.
- Focus on energy intensity and energy recovery by upgrading or replacing old technologies with the best contemporary systems. Some of the digital elements to the 4th Industrial Revolution is the development of Direct Digital Manufacturing (DDM), which is considered to be a key aspect of modern manufacturing.
- Adopt live cycle analysis which is a systematic set of techniques for observing the inputs and outputs of resources including energy and the related environmental factors directly attributable to the cost object all the way through its life cycle.

Effect of Climate Change on the Manufacturing Sector

- Improve food packaging in order to increase shelf-lives. The United Nations Environmental Programme reported that 33.33% of all food produced in the world is wasted and that contributes approximately 10% to global greenhouse gas emissions.
- Pay attention to waste reduction. Industries should form industrialized clusters in which costly resources or facilities are shared and the waste of one manufacture becomes the input material for other.
- Classifying and recognize possible risk impacts and prioritize those that are significant.
- Set emission reduction targets from short term to long term periods.
- Position the threats and benefits of climate change within the sector's governance structure.
- Existing buildings that are at risk must be reconstructed. Although this option might be costly for some developing economies, but prevention is better than cure. New buildings on the other hand must be designed for future climate conditions. For example, concrete is made of a collection of small stones which are held together with the framework of the rejoined cement, therefore, industries need to look at new ways to glue concrete or brick with sand with low carbon dioxide emissions and low energy consumption.
- There must be industrialized traffic reports during extreme weather events. Manufactures can constantly receive updated traffic and weather reports.
- Mitigate and adapt to climate change. All business activities must be designed to accommodate climate conditions.

Eradicate Greenhouse Gas Emissions

The first step for manufacturers to reduce greenhouse gas emissions is to consult research associations or bodies who are experts in greenhouse issues (STAPPA and ALAPCO, 1999). Ridoutt et al (2016) advise that other possible ways include the use of renewable energy sources, installing energy efficient lighting in buildings, using energy efficient facilities, and planting of trees, as well as more efficient use and recycling of materials, and installation and use of water saving facilities. The unnecessary burning of materials such as coal and oil escalates the volume of carbon dioxide (CO₂) in the air as the course of burning combines carbon with oxygen in the air to make CO₂. Most importantly, assessing the amount of pollution generated by the sector is imperative in order for a clear strategy to improve processes, product management, changed green procurement, and carbon capture, as well as consumption plans to be undertaken ahead of time. Since climate is here to stay, continuous management training and education on climate change is recommended. Such training must also be offered to employees of the organization.

THE NEED FOR MANUFACTURES TO ADAPT TO CLIMATE CHANGE

There are pressing advantages and disadvantages of climate change in the manufacturing sector which make it worth addressing which are as follows:

Advantages

Although climate change is so often discussed in meeting rooms, fewer people have seen it as a business opportunity. A study conducted by Deloitte reports that the low carbon transition has a possibility

to produce opportunities for innovation, productivity and growth for many industries (Coppola, Krick and Blohmke, 2019). This means that the manufactures can actually save energy, money, improve customer service, enhance internal goodwill, and better draw and retain talent; all as a result of working to moderate gas emissions. Research undertaken by Wyman (2020) and report by Harvard gazette (2019), present the following:

- Some businesses from developed countries have realized significant operating cost reductions on gas emissions declines;
- Climate change has imposed changes in working arrangements including a shift to remote working. This provides opportunities to reduce transport costs and cut office use and energy costs;
- The need for low carbon transition is creating demand for new projects; and
- In ten years' time, electric passenger vehicles may account for nearly 30% of global trades.

Disadvantages

While there is a promise of opportunities from climate change for manufactures, United Nations Asian and Pacific Training Centre for Information and Communication Technology for Development (2013) reports that climate is still expected to be detrimental in the sector as follows:

- By the 2080s, many more manufactures than today are expected to experience ocean breakouts every year due to sea level rise;
- widespread reductions in snow are projected to speed up throughout the 21st century, reducing hydropower or water power potential, water availability, and changing seasonality of water flows in countries supplied by melt water from mountain ranges;
- Runoff is projected with high confidence to increase by 10 to 40 per cent by mid-century in some wet tropical areas, including populous areas in East and South-East Asia. Due to drops in rainfall and increases of evapotranspiration, runoff is expected to cut by 10 to 30 per cent in some regions;
- Due to worm weather conditions, more non-native species are expected to invade the earth, mainly on mid and high latitude islands; and
- Sever weather conditions experienced along the seaside is expected to affect local resources.

Hauke, Per-Anders and Kimberly (2015) categorize climate disadvantages into two major distinct factors: value chain risks and external stakeholders' risks. Value chain risks include **physical** (damage imposed on infrastructure including supply chain operations), **prices** (costs of raw materials and other supplies) and **product** (products becoming unpopular and unmarketable). External stakeholders' risks on the other hand refer to **rating** (greater costs of capital due to climate changes), **reputation** (can be both direct, coming from an industry action or policy, or indirect, in the form of public insight about the sector) and **regulations** (government action provoked by climate change). It is clear from literature point of view that disadvantages of climate change are part of a larger trend with worrying environmental erosions while investors, customers and employees are demanding business sustainability from the manufactures.

FUTURE RESEARCH DIRECTIONS

In order to validate the theoretical assumptions on the effect of climate on the manufacturing sector, it is recommended that empirical studies be conducted in both developed and developing countries.

CONCLUSION

The chapter conducted a review of the effect of climate change on the manufacturing sector. Extreme weather conditions experienced around the world require scientific attention and awareness as these extremes are expected to increase. The effect of climate on manufacturing, as discussed in this chapter, include the fact that climate has a severe effect on productivity, as well as posing human and business risks, and destroying sensitive goods and services used to sustain human lives and livelihoods. Moreover, positioning the manufacturing sector against climate change was also discussed, which includes the need to become a leading partner in sustainable manufacturing, adapting to climate change, and eradicating greenhouse gas emissions. Therefore, the central contribution of the chapter resides in the fact that it enlightens society on the effect of climate change on manufacturing and what can be done to counteract the severe results of climate change on manufacturing around the world.

REFERENCES

- Ackerman, F., & Stanton, E. A. (2017). *The cost of climate change. What we'll pay if global warming continues unchecked?* Retrieved from <https://www.nrdc.org/sites/default/files/cost.pdf>
- Berkhout, F., Hertin, J., & Gann, D. M. (2006). Learning to adapt: Organisational adaptation to climate change impacts. *Climatic Change*, 78(1), 136. doi:10.1007/10584-006-9089-3
- Camilleri, M., Jaques, R., & Isaacs, N. (2001). *Climate change impacts on building performance*. Retrieved from <https://www.irbnet.de/daten/iconda/CIB3008.pdf>
- Chemical industries association. (2015). *Safeguarding chemical businesses in a changing climate. How to prepare a climate change adaptation plan?* Retrieved from <https://www.cia.org.uk/LinkClick.aspx?fileticket=KW8WF8CBZG0%3D&portalid=0>
- Coppola, M., Krick, T., & Blohmke, J. (2019). *Companies are under pressure on climate change and need to do more: Feeling the heat?* Retrieved from <https://www2.deloitte.com/us/en/insights/topics/strategy/impact-and-opportunities-of-climate-change-on-business.html>
- Crutzen, P. J., & Eugene, F. S. (2000). The "Anthropocene.". *Global Change Newsletter*, (41), 17–18. https://placesjournal.org/article/landscape-migration/?gclid=cj0kcqiaj9ibbhjarisae9qrtaj5bzhcwoq6n5xhzhk_fd9kgcssx07_2o5vw7cpf99vxaqls_9iaaqozealw_wcb
- Curphey, M. (2019). *Industries most vulnerable to climate change. Global warming and climate change pose a seemingly ever-increasing global risk, but can the damage be repaired or even halted?* Retrieved from <https://csuite.raconteur.net/business-risk/industries-most-vulnerable-to-climate-change/>

- Deloitte. (2019). *How insurance companies can prepare for risk from climate change. Industry regulators sharpen their focus*. Retrieved from <https://www2.deloitte.com/us/en/pages/financial-services/articles/insurance-companies-climate-change-risk.html>
- Dhanai, R., Negi, R. S., Singh, S., & Parmar, M. K. (2014). The effects of climate change on natural resources and socio-economic condition of Himalayan communities of Uttarakhand, India. *International Journal of Modern Communication Technologies & Research*, 2(11), 22. <https://media.neliti.com/media/publications/265749-the-effects-of-climate-change-on-natural-700dbe88.pdf>
- Dobrinevski, A., & Jachnik, R. (2020). *Exploring options to measure the climate consistency of real economy investments: The manufacturing industries in Norway*. Retrieved from <https://www.oecd-ilibrary.org/docserver/1012bd81-en.pdf?expires=1614255683&id=id&accname=guest&checksum=4E68612131B78D3533AE156F8B52F5AD>
- Drzik, J. P. (2020). *The heat is on businesses to respond to climate change*. Retrieved from <https://www.weforum.org/agenda/2020/01/climate-change-business-response-risks/>
- Ehrhart, M. G., & Kuenzi, M. (2017). *The impact of organizational climate and culture on employee turnover*. doi:10.1002/9781118972472.ch231
- Europa, B. (2019). *The chemical industry's contributions to climate change*. Retrieved from: <https://bellona.org/news/eu/2019-04-the-industrys-chemistry-with-climate-change>
- Folk, E. (2018). *How climate change will affect businesses*. Retrieved from <https://www.renewableenergy-magazine.com/emily-folk/how-climate-change-will-affect-businesses-20181109>
- Frayne, B., Moser, C., & Ziervogel, G. (2012). *Climate change, assets and food security in Southern African cities*. Retrieved from <https://www.routledge.com/Climate-Change-Assets-and-Food-Security-in-Southern-African-Cities/Frayne-Moser-Ziervogel/p/book/9780815357445>
- Gambarelli, G. (2020). *Climate change, new risks and opportunities for businesses. Businesses should evaluate the risks and opportunities of climate change and its mitigation to ensure their long-term resilience and success*. Retrieved from <https://www.lifegate.com/climate-change-risks-opportunities-businesses>
- Ghazouani, A., Xia, W., Jebli, M. B., & Shahzad, U. (2020). Exploring the role of carbon taxation policies on CO₂ emissions: Contextual evidence from tax implementation and non-implementation European countries. *Sustainability*, 12(20), 4. doi:10.3390/u12208680
- Gordon, R. K. (1998). *Depreciation, amortization, and depletion*. Retrieved from <https://www.imf.org/external/pubs/nft/1998/tlaw/eng/ch17.pdf>
- Great Lakes Integrated Sciences Assessment. (2009). *Climate change impacts on natural resources*. Retrieved from <https://www.hrwc.org/wp-content/uploads/HRWC-Natural-Resources.pdf>
- Gregory, A. A., & Angelina, C. S. (2006). Organizational climate partially mediates the effect of culture on work attitudes and staff turnover in mental health services. *Administration and Policy in Mental Health*, 3(33), 299. doi:10.1007/10488-006-0039-1

Effect of Climate Change on the Manufacturing Sector

Harvard Gazette. (2019). *Business opportunities from climate change: News from Harvard schools, offices, and affiliates*. Retrieved from <https://news.harvard.edu/gazette/story/newsplus/business-opportunities-from-climate-change/>

Hauke, E., Per-Anders, E., & Kimberly, H. (2015). *How companies can adapt to climate change: Taking effective action can turn risk into competitive advantage*. Retrieved from <https://www.mckinsey.com/business-functions/sustainability/our-insights/how-companies-can-adapt-to-climate-change#>

Hoyt, D. V., & Schatten, K. H. (1997). *The role of the sun in climate change*. Oxford University Press. doi:10.1093/oso/9780195094138.001.0001

Insulated Products Corp. (2015). *5 Most temperature-sensitive products that require cold chain packaging*. Retrieved from <https://ipcpack.com/5-most-temperature-sensitive-products-require-cold-chain-packaging/>

Kenya Private Sector Alliance. (2014). *Climate change and the energy and manufacturing sector*. Retrieved from <http://www.warmheartworldwide.org/environmental/progressnews>

Linnenluecke, M. K., Griffiths, A., & Winn, M. I. (2013). Firm and industry adaptation to climate change: A review of climate adaptation studies in the business and management field. *Wiley Interdisciplinary Reviews: Climate Change*, 4(2), 400. doi:10.1002/wcc.214

Mann, M. E., & Kump, L. R. (2012). *An introduction to climate change*. Retrieved from <https://clean.ns.ca/climate-change-background-info/>

Methane, S. A. T. (2019). *MethaneSAT: Putting the brakes on climate change: Key technical considerations*. Retrieved from <https://www.edf.org/sites/default/files/MethaneSAT%20Technical%20considerations-May%202019.pdf>

Mitchell, G. R. (2017). Climate change and manufacturing. *Procedia Manufacturing*, 12, 298–306. doi:10.1016/j.promfg.2017.08.033

Morrell, K. M., Loan-Clarke, J., & Wilkinson, A. J. (2004). Organisational change and employee turnover. *Personnel Review*, 32(2), 163–164.

Muhammad, I. R. (2012). Climate change: A theoretical review. *Interdisciplinary Description of Complex Systems*, 11(1), 3. doi:10.7906/indecs.11.1.1

Nabegu, A. B., & Ali, N. (2016). Climate change: the scientific basis, misconceptions, impacts and global response. *Environmental Pollution*. Retrieved from https://www.researchgate.net/publication/310844052_Climate_Change_the_scientific_basis_misconceptions_impacts_and_global_response

National Treasury. (2019). *Estimates of national expenditure. 2019 budget estimate for national expenditure*. Retrieved from <http://www.treasury.gov.za/documents/national%20budget/2019/enebooklets/Vote%2027%20Environmental%20Affairs.pdf>

National Treasury. (2018). *Explanatory memorandum on the carbon tax bill, 2018*. Retrieved from <http://www.treasury.gov.za/public%20comments/CarbonTaxBill2019/Explanatory%20Memorandum%20to%20the%202018%20Carbon%20Tax%20Bill%20-%202020%20Nov%202018.pdf>

- Price Waterhousecoopers. (2010). *A practical guide to accounting for property under the cost model*. Retrieved from https://www.pwc.com/jp/en/assurance/research-insights-report/assets/pdf/imre_22en.pdf
- Pye, E. K. (2016). *How will climate change the chemical industry?* Retrieved from <https://www.lrsm.upenn.edu/event/how-will-climate-change-change-chemical-industry/>
- Rayner, R. (2010). *Incorporating climate change within asset management*. Retrieved from <https://www.lse.ac.uk/newsletters/CATS/pdfs/Asset%20Management%20-%20Final%20Proof.pdf>
- Ridoutt, B., Sanguansri, P., Bonney, L., Crimp, S., Lewis, G., & Lim-Camacho, L. (2016). *Climate change adaptation strategy in the food industry—insights from product carbon and water footprints*. Retrieved from <https://webcache.googleusercontent.com/search?q=cache:nFzQ1-AyoYwJ:https://www.mdpi.com/2225-1154/4/2/26/pdf+&cd=1&hl=en&ct=clnk&gl=za>
- Seacrest, S., Kuzelka, R., & Leonard, R. (2000). Global climate change and public perception: The challenge of translation. *Journal of the American Water Resources Association*, 36(2), 254. doi:10.1111/j.1752-1688.2000.tb04265.x
- State and Territorial Air Pollution Program Administrators (STAPPA) & Association of Local Air Pollution Control Officials (ALAPCO). (1999). *Reducing greenhouse gases and air pollution: a menu of harmonized options*. Retrieved from <https://www.oecd.org/environment/cc/2055676.pdf>
- Streletskiy, D. A., Suter, L. J., Shiklomanov, N., Porfiriev, B. N. & Eliseev, D. O. (2019). Assessment of climate change impacts on buildings, structures and infrastructure in the Russian regions on permafrost. *Environmental Research Letters*, 14, 13. doi:10.1088/1748-9326/aaf5e6
- United Nations Asian and Pacific Training Centre for Information and Communication Technology for Development. (2013). *Primer series on ICTD for youth. Primer 4: An introduction to ICT, climate change and green growth*. Retrieved from https://www.preventionweb.net/files/47535_primer4ictclimatechange.pdf
- United Nations Framework Convention on Climate Change. (1994). *United nations framework convention on climate change: Convention*. Retrieved from https://unfccc.int/essential_background/convention/background/items/2536.php
- United Nations Framework Convention on Climate Change. (2011). *Climate change science – the status of climate change science today: Fact sheet*. Retrieved from https://unfccc.int/files/press/backgrounders/application/pdf/press_factsh_science.pdf
- Wyman, O. (2020). *Climate change is an opportunity for business to thrive*. Retrieved from <https://www.oliverwyman.com/our-expertise/insights/2020/oct/climate-change-is-an-opportunity-for-business-to-thrive.html>
- Yildiz, G., & Şeren, K. (2020). Tax as a Solution for Climate Change. *Contemporary Issues in Business Economics and Finance*, 104, 165–178. doi:10.1108/S1569-375920200000104011
- Yu, S., & Xinpeng, X. (2019). The productivity impact of climate change: Evidence from Australia's Millennium drought. *Economic Modelling*, 76(1), 182–191. doi:10.1016/j.econmod.2018.07.031

Compilation of References

- Thomas, A. (2015). *Why is Hyderabad's Residential Market not yet booming?* Academic Press.
- Yalpir, S., Durduran, S. S., Unel, F. B., & Yolcu, M. (2014). Creating a Valuation Map in GIS Through Artificial Neural Network Methodology: A Case Study. *Acta Montanistica Slovaca*, 19, 89–99.
- Fan, G. Z., Ong, S. E., & Koh, H. C. (2006). Determinants of house price: A decision tree approach. *Urban Studies (Edinburgh, Scotland)*, 43(12), 2301–2315. doi:10.1080/00420980600990928
- Vapnik, V. (1995). *The Nature of Statistical Learning Theory*. Springer. doi:10.1007/978-1-4757-2440-0
- Kontrimas, V., & Verikas, A. (2011). The mass appraisal of the real estate by computational intelligence. *Applied Soft Computing*, 11(1), 443–448. doi:10.1016/j.asoc.2009.12.003
- Yu, D., & Wu, C. (2006). Incorporating Remote Sensing Information in Modeling House Values. *Photogrammetric Engineering and Remote Sensing*, 72(2), 129–138. doi:10.14358/PERS.72.2.129
- Breiman, L. (2001). Random forests. *Machine Learning*, 45(1), 5–32. doi:10.1023/A:1010933404324
- Antipov, E. A., & Pokryshevskaya, E. B. (2012). Mass appraisal of residential apartments: An application of Random forest for valuation and a CART-based approach for model diagnostics. *Expert Systems with Applications*, 39(2), 1772–1778. doi:10.1016/j.eswa.2011.08.077
- Yoo, S., Im, J., & Wagner, J. E. (2012). Variable selection for hedonic model using machine learning approaches: A case study in Onondaga County, NY. *Landscape and Urban Planning*, 107(3), 293–306. doi:10.1016/j.landurbplan.2012.06.009
- Li, J., Hu, Y., & Liu, C. (2020). Exploring the Influence of an Urban Water System on Housing Prices. *Case Study of Zhengzhou. Buildings*, 10, 44.
- Mittal & Bhargava. (2014). *Advocates & Legal Consultants: An Overview on Indian Real Estate*. Academic Press.
- Nourse, H. O. (1967). The Effect of Air Pollution on House Values. *Land Economics*, 43(2), 181–189. doi:10.2307/3145241
- Tan, J., & Zhao, J. (2014). The value of clean air in China: Evidence from Beijing and Shanghai. *Frontiers of Economics in China*, 9, 109–137.
- Wang, X. J., Zhang, W., Li, Y., Yang, K. Z., & Bai, M. (2006). Air quality improvement estimation and assessment using contingent valuation method, a case study in Beijing. *Environmental Monitoring and Assessment*, 120(1-3), 153–168. doi:10.1007/10661-005-9054-z PMID:16770506
- Chau, K., Yiu, C., Wong, S., & Lai, L. W. C. (2003). Hedonic price modelling of environmental attributes: A review of the literature and a Hong Kong case study. In W. C. L. Lawrence & L. Frank (Eds.), *Understanding and Implementing Sustainable Development* (pp. 87–110). Nova Science Publication.

- Chen, L., Yao, X., Liu, Y., Zhu, Y., Chen, W., Zhao, X., & Chi, T. (2020). Measuring impacts of urban environmental elements on housing prices based on multisource data – a case study of Shanghai, China. *ISPRS Int. J. Geo-Inform.*, *9*(2), 106.
- Zhang, F., Zu, J., Hu, M., Zhu, D., Kang, Y., Gao, S., Zhang, Y., & Huang, Z. (2020). Uncovering inconspicuous places using social media check-ins and street view images. *Computers, Environment and Urban Systems*, *81*, 101478. doi:10.1016/j.compenvurbsys.2020.101478
- Fu, X., Jia, T., Zhang, X., Li, S., & Zhang, Y. (2019). Do street-level scene perceptions affect housing prices in Chinese megacities? an analysis using open access datasets and deep learning. *PLoS One*, *14*(5), e0217505. doi:10.1371/journal.pone.0217505 PMID:31145767
- Law, S., Paige, B., & Russell, C. (2018). *Take a Look Around: Using Street View and Satellite Images to Estimate House Prices*. arXiv: 180707155.
- Ridker, R. G., & Henning, J. A. (1967). The determinants of residential property values with special reference to air pollution. *The Review of Economics and Statistics*, *49*(2), 246–257. doi:10.2307/1928231
- Wieand, K. F. (1973). Air pollution and property values: A study of the St. Louis area. *Journal of Regional Science*, *13*(1), 91–95. doi:10.1111/j.1467-9787.1973.tb00380.x
- Selim, S. (2008). Determinant of House Price in Turkey: A Hedonic Regression Model, Dogus. *Universities Dergisi*, *9*(1), 65–76. doi:10.31671/dogus.2019.223
- Smith, V. K., & Deyak, T. A. (1975). Measuring the impact of air pollution on property values. *Journal of Regional Science*, *15*(3), 277–288. doi:10.1111/j.1467-9787.1975.tb00931.x
- Harrison, D. Jr, & Rubinfeld, D. L. (1978). Hedonic housing prices and the demand for clean air. *Journal of Environmental Economics and Management*, *5*(1), 81–102. doi:10.1016/0095-0696(78)90006-2
- Nelson, J. P. (1979). Airport noise, location rent, and the market for residential amenities. *Journal of Environmental Economics and Management*, *6*(4), 320–331. doi:10.1016/0095-0696(79)90011-1
- Li, M. M., & Brown, H. J. (1980). Micro-neighborhood externalities and hedonic housing prices. *Land Economics*, *56*(2), 125–141. doi:10.2307/3145857
- Murdoch, J. C., & Thayer, M. A. (1988). Hedonic price estimation of variable urban air quality. *Journal of Environmental Economics and Management*, *15*(2), 143–146. doi:10.1016/0095-0696(88)90014-9
- Chattopadhyay, S. (1999). Estimating the demand for air quality: New evidence based on the Chicago housing market. *Land Economics*, *75*(1), 22–38. doi:10.2307/3146991
- Zabel, J. E., & Kiel, K. A. (2000). Estimating the demand for air quality in four U.S. cities. *Land Economics*, *76*(2), 174–194. doi:10.2307/3147223
- Boyle, M. A., & Kiel, K. A. (2001). A survey of house price hedonic studies of the impact of environmental externalities. *Journal of Real Estate Literature*, *9*(2), 117–144. doi:10.1080/10835547.2001.12090098
- Bayer, P., Keohane, N., & Timmins, C. (2009). Migration and hedonic valuation: The case of air quality. *Journal of Environmental Economics and Management*, *58*(1), 1–14. doi:10.1016/j.jeem.2008.08.004
- Yusuf, A. A., & Resosudarmo, B. P. (2009). Does clean air matter in developing countries' megacities? A hedonic price analysis of the Jakarta housing market, Indonesia. *Ecological Economics*, *68*(5), 1398–1407. doi:10.1016/j.ecolecon.2008.09.011

Compilation of References

- Topco, M., & Kubat, A. S. (2009). Konut bölgelerinde Mekansal Yapı. *Arazi Değer İlişkisi*, (332), 17 – 26.
- Bajari, P., Fruehwirth, J. C., Kim, K. I., & Timmins, C. (2010). A rational expectations approach to hedonic price regressions with time-varying unobserved product attributes: The price of pollution. *The American Economic Review*, 102(5), 1898–1926. doi:10.1257/aer.102.5.1898
- Chen, Y. W., & Chen, L. Z. (2012). Pricing for clean air: Evidence from Qingdao. *Japan and the World Economy*, 4, 140–160.
- Zhang, B., & Huang, X. (2017). Peking University A price evaluation of air quality in China. *Res. Econ. Manag.*, 38, 94–103.
- Zhang, X., Zhang, X. B., & Chen, X. (2017). Valuing Air Quality Using Happiness Data: The Case of China. *Ecological Economics*, 137, 29–36. doi:10.1016/j.ecolecon.2017.02.020 PMID:28989234
- Ligus, M. (2018). Measuring the Willingness to Pay for Improved Air Quality: A Contingent Valuation Survey. *Polish Journal of Environmental Studies*, 27(2), 763–771. doi:10.15244/pjoes/76406
- Carriazo, F., & Alexander, J. (2018). The demand for air quality: Evidence from the housing market in Bogotá, Colombia. *Environment and Development Economics*, 23(2), 121–138. doi:10.1017/S1355770X18000050
- Hitaj, C., Lynch, L., McConnell, K. E., & Tra, C. I. (2018). The Value of Ozone Air Quality Improvements to Renters: Evidence from Apartment Building Transactions in Los Angeles County. *Ecological Economics*, 146, 706–721. doi:10.1016/j.ecolecon.2017.12.022
- Wang, Y., Wang, S. J., Li, G. D., Zhang, H. G., Jin, L. X., Su, Y. X., & Wu, K. M. (2017). Identifying the determinants of housing prices in China using spatial regression and the geographical detector technique. *Applied Geography (Sevenoaks, England)*, 79, 26–36. doi:10.1016/j.apgeog.2016.12.003
- Izón, G. M., Hand, M. S., Mccollum, D. W., Thacher, J. A., & Berrens, R. P. (2016). Proximity to Natural Amenities: A Seemingly Unrelated Hedonic Regression Model with Spatial Durbin and Spatial Error Processes. *Growth and Change*, 47(4), 461–480. doi:10.1111/grow.12147
- Montero, J. M., Minguez, R., Fernandez, A., & Fernandez-Aviles, G. (2018). Housing price prediction: Parametric versus semi-parametric spatial hedonic models. *Journal of Geographical Systems*, 20(1), 27–55. doi:10.1007/10109-017-0257-y
- SDC Companies Development Services. (2015). *MGT Radiance*. Author.
- De, U. K., & Vupru, V. (2017). Location and neighbourhood conditions for housing choice and its rental value: Empirical examination in an urban area of North-East India. *Int. J. Hous. Markets Anal.*, 10(4), 519–538. doi:10.1108/IJHMA-10-2016-0072
- Zhang, H. Y., & Wang, X. Y. (2016). Effectiveness of Macro-regulation Policies on Housing Prices: A Spatial Quantile Regression Approach. *Hous. Theor. Soc.*, 33, 23–40.
- Anselin, L., & Lozanogracia, N. (2008). Errors in variables and spatial effects in hedonic house price models of ambient air quality. *Empirical Economics*, 34(1), 5–34. doi:10.1007/00181-007-0152-3
- Sullivan, D. M. (2016). *The True Cost of Air Pollution: Evidence from House Prices and Migration*. Harvard University. Massachusetts Hall Cambridge.
- Tian, G., Wei, Y. D., & Li, H. (2017). Effects of accessibility and environmental health risk on housing prices: A case of Salt Lake County, Utah. *Applied Geography (Sevenoaks, England)*, 89, 12–21. doi:10.1016/j.apgeog.2017.09.010

- Li, H., Wei, Y. D., Yu, Z., & Tian, G. (2016). Amenity, accessibility and housing values in metropolitan USA: A study of Salt Lake County, Utah. *Cities (London, England)*, 59, 113–125. doi:10.1016/j.cities.2016.07.001
- Neelawala, P., Wilson, C., & Athukorala, W. (2012). The impact of mining and smelting activities on property values: A study of Mount Isa city, Queensland, Australia. *The Australian Journal of Agricultural and Resource Economics*, 5(7), 60–78.
- Chasco, C., & Sánchez, B. (2015). *Valuation of environmental pollution in the city of Madrid: An application with hedonic models and spatial quantile regression*. Rev. Déconomie Rég. Urbaine.
- Chasco, C., & Gallo, J. L. (2015). Heterogeneity in Perceptions of Noise and Air Pollution: A Spatial Quantile Approach on the City of Madrid. *Spatial Economic Analysis*, 10(3), 317–343. doi:10.1080/17421772.2015.1062127
- Chen, D., & Chen, S. (2017). Particulate air pollution and real estate valuation: Evidence from 286 Chinese prefecture-level cities over 2004–2013. *Energy Policy*, 109, 884–897. doi:10.1016/j.enpol.2017.05.044
- Lieser & Groh. (2011). The Determinants of International Commercial Real Estate Investments. *IESE Business School*, 935.
- Jia, Y. (2014). *An Empirical Study on the Relationship between Urban Air Quality and Commercial Housing Price* (Master's Thesis). Tianjin Normal University, Tianjin, China.
- Wang, S., & Shi, J. (2019). Study on regional difference of air quality's impact on urban housing price. *Prices Mon.*, 10, 14–21.
- Kong, N. (2018). *Empirical Research on the Impact of Air Pollution on China's Real Estate Market* (Master's Thesis). Xiamen University, Xiamen, China.
- Das, P., Sah, V., Sharma, D., Singh, V., & Galuppo, L. (2013). Real Estate Development Process in India. *Journal of Real Estate Literature*, 21(2), 271–292. doi:10.1080/10835547.2013.12090362
- Ramprakash Kona, Rao, & Prasad. (2016). Trends in Indian Realty Sector - A CRM Framework for Real Estate Entities in the Changing Environment. *International Journal of Innovative Research and Development*, 5(7), 165–175.
- Wadhvani. (2009). *Opportunities and Challenges of investing in Indian Real Estate*. Academic Press.
- Ranjan, S. (2013). Indian real estate: the year gone by and outlook. EY.
- Abdelzaher, D. M., Martynov, A., & Zaher, A. M. A. (2020). Vulnerability to climate change: Are innovative countries in a better position? *Research in International Business and Finance*, 51, 101098. doi:10.1016/j.ribaf.2019.101098
- Abdou, A. H., Hassan, T. H., Dief, E., & Moustafa, M. (2020). A Description of Green Hotel Practices and Their Role in Achieving Sustainable Development. *Sustainability*, 12(22), 9624.
- Abdulredha, M., Al Khaddar, R., Jordan, D., Kot, P., Abdulridha, A., & Hashim, K. (2018). Estimating solid waste generation by hospitality industry during major festivals: A quantification model based on multiple regression. *Waste Management (New York, N.Y.)*, 77, 388–400.
- Abeysekera, I. (2013). A template for integrated reporting. *Journal of Intellectual Capital*, 14(2), 227–245. doi:10.1108/14691931311323869
- Abia, W. A., Onya, C. A., Shum, C. E., Amba, W. E., Niba, K. L., & Abia, E. A. (2020). Food Security Concerns, Climate Change and Sea Level Rise in Coastal Cameroon. *African Handbook of Climate Change Adaptation*, 1-13.
- Abigail, A. (2003). Maynard. Reducing Fertilizer Requirements in Cut Flower Production. *BioCycle*, 44(43).

Compilation of References

- Abiodun, B. J., Salami, A. T., Matthew, O. J., & Odedokun, S. (2013). Potential impacts of afforestation on climate change and extreme events in Nigeria. *Climate Dynamics*, 41(2), 277–293. doi:10.1007/00382-012-1523-9
- Abisuga-Oyekunle, O. A., Patra, S. K., & Muchie, M. (2020). SMEs in sustainable development: Their role in poverty reduction and employment generation in sub-Saharan Africa. *African Journal of Science, Technology, Innovation and Development*, 12(4), 405–419. doi:10.1080/20421338.2019.1656428
- ACCA. (2013). *Improving natural capital reporting and finding the tools to help*. <https://www.accaglobal.com/content/dam/acca/global/PDF-technical/sustainabilityreporting/tech-tp-incr.pdf>
- Access Bank Plc. (2020). *2019 Annual Report and Accounts*. Author.
- Ackerman, F., & Stanton, E. A. (2017). *The cost of climate change. What we'll pay if global warming continues unchecked?* Retrieved from <https://www.nrdc.org/sites/default/files/cost.pdf>
- Act of 27 April 2001. Environmental protection law, Journal of Laws 2001 no 62 item 627.
- Adam, I. O., & Musah, A. (2015). Small and medium enterprises (SMEs) in the cloud in developing countries: A synthesis of the literature and future research directions. *Journal of Management and Sustainability*, 5(1), 115. doi:10.5539/jms.v5n1p115
- Adam-Poupart, A., Labrèche, F., Smargiassi, A., Duguay, P., Busque, M. A., Gagné, C., & Zayed, J. (2013). Climate change and occupational health and safety in a temperate climate: Potential impacts and research priorities in Quebec, Canada. *Industrial Health*, 51, 68–78. doi:10.2486/indhealth.2012-0100 PMID:23411758
- Adebayo, O. O. (2012). Climate Change Perception and Adaptation Strategies on Catfish Farming in Oyo State, Nigeria. *Global Journal of Science and Frontier Researcher and Agricultural Veterinary Science*, 12(6), 24–28.
- Adebisi-Adelani, O., & Oyesola, O. (2014). Farmers' perceptions of the effect of climate change on tomato production in Nigeria. *International Journal of Vegetable Science*, 20(4), 366–373. doi:10.1080/19315260.2013.813890
- Adegboyegun, A. E., Alade, M. E., Ben-Caleb, E., Ademola, A. O., Eluyela, D. F., & Oladipo, O. A. (2020). Integrated reporting and corporate performance in Nigeria: Evidence from the banking industry. *Cogent Business & Management*, 7(1), 1–12. doi:10.1080/23311975.2020.1736866
- Adger, W. N., Huq, S., Brown, K., Conway, D., & Hulme, M. (2003). Adaptation to climate change in the developing world. *Progress in Development Studies*, 3(3), 179–195. doi:10.1191/1464993403ps060oa
- Adisa, T. A., Abdulraheem, I., & Mordi, C. (2014). The Characteristics and Challenges of Small Businesses in Africa: An Exploratory Study of Nigerian Small Business Owners. *Petroleum-Gas University of Ploiesti Bulletin. Technical Series*, 66(4), 1–14.
- Adriana, B. (2019). Green Marketing mix: A case study of Brazilian retail enterprises. *J. Environ Qual. Manag.*, 28(3), 111–116. doi:10.1002/tqem.21608
- Aduda, J., & Kalunda, E. (2012). Financial inclusion and financial sector stability with reference to Kenya: A review of literature. *Journal of Applied Finance and Banking*, 2(6), 95.
- Advisory Power Team, Office of the Vice President of Nigeria & Power Africa. (2015). *Nigeria baseline power report*. Retrieved from <https://mypower.ng/wp-content/uploads/2018/01/Baseline-Report.pdf>
- Afionis, S. (2017). *The European Union in international climate change negotiations*. Taylor & Francis. doi:10.4324/9781315773469

- Africa Economic Outlook. (2014). *Global Value Chains and Africa's Industrialisation. Pocket Edition*. OECD Development Centre.
- Afroz, N. N. (2017). Green banking initiatives of Islamic bank Bangladesh limited. *Global Journal of Management and Business Research*, 17(1), 1–8.
- Agan, Y., Acar, M. F., & Borodin, A. (2013). Drivers of environmental processes and their impact on performance: A study of Turkish SMEs. *Journal of Cleaner Production*, 51, 23–33. doi:10.1016/j.jclepro.2012.12.043
- Agbanifo, B. A., & Yomere, G. O. (1991). *Research Methodology* (1st ed.). University Press University of Benin.
- Agbola, P., & Fayiga, A. O. (2016). Effects of climate change on agricultural production and rural livelihood in Nigeria. *Journal of Agricultural Research and Development*, 15(1).
- Agbola, P., & Fayiga, A. O. (2016). Effects of Climate Change on Agricultural Production and Rural Livelihoods in Nigeria. *Journal of Agricultural Research and Development*, 15(1).
- Aggarwal, P., & Singh, A. K. (2019). CSR and sustainability reporting practices in India: An in-depth content analysis of top-listed companies. *Social Responsibility Journal*, 15(8), 1033–1053. doi:10.1108/SRJ-03-2018-0078
- Aggarwal, R. (2012). Innovative distribution channels and their effectiveness in Indian life insurance industry. *Asian Journal of Research in Banking and Finance*, 2(10), 39–47.
- Aglietta, M., & Espagne, E. (2016). *Climate and finance systemic risks, more than an analogy? The Climate Fragility Hypothesis*. CEPII Working Paper 2016-10.
- Agustia, D., Sawarjuwono, T., & Dianawati, W. (2019). The mediating effect of environmental management accounting on green innovation-Firm value relationship. *International Journal of Energy Economics and Policy*, 9(2), 299–306.
- Agwu, E. A., & Anyanwu, A. C. (1996). Socio-cultural and environmental constraints in implementing the NALDA programme in south eastern Nigeria. A case study of Abia and Enugu State. *Journal of Agricultural Education*, 2, 68–72.
- Ahi, P., & Searcy, C. (2013). A comparative literature analysis of definitions for green and sustainable supply chain management. *Journal of Cleaner Production*, 52, 329–341. doi:10.1016/j.jclepro.2013.02.018
- Ahmed, M. (2020). Introduction to Modern Climate Change. Andrew E. Dessler: Cambridge University Press, 2011, 252 pp, ISBN-10: 0521173159. *The Science of the Total Environment*, 734(May), 139397. doi:10.1016/j.scitotenv.2020.139397
- Ajor, L., & Alikor, L. O. (2020). Innovative mindset and organizational sustainability of small and medium enterprises in rivers state, Nigeria. *British J. Manag. Market. Stud*, 3(1), 20–36.
- Akanbi, B. E., Adagunodo, M., & Satope, B. F. (2014). Climate Change, Human Development and Economic Growth in Nigeria. *International Journal of Humanities and Social Science*, 4, 1–7.
- Akanwa & Joe-Ikechebelu (2019). *The Developing World's Contribution to Global Warming and the Resulting Consequences of Climate Change in These Regions: A Nigerian Case Study*. . doi:10.5772/intechopen.85052
- Akanwa, A. O., & Joe-Ikechebelu, N. (2019). The Developing World's Contribution to Global Warming and the Resulting Consequences of Climate Change in These Regions: A Nigerian Case Study. In *Global Warming and Climate Change*. IntechOpen.
- Akilli, H., Kemahli, F., Okudan, K., & Polat, F. (2008). The content of ecological footprint concept and calculation of individual ecological footprint in the Akdeniz University economics and administrative sciences faculty. *Akdeniz İİBF Journal*, 8(15), 1-25. Retrieved from <https://dergipark.org.tr/tr/pub/auibfd/issue/32317/359129>

Compilation of References

- Akinbile, L. A., Aminu, O. O., & Kolade, R. I. (2018). Perceived Effect of Climate Change on Forest Dependent Livelihoods in Oyo State, Nigeria. *Journal of Agricultural Extension*, 22(2), 169–179. doi:10.4314/jae.v22i2.15
- Akinngbe, O.M., & Irohibe, I.J. (2014). Agricultural Adaptation strategies to climate change impacts in Africa: A Review. *Bangladesh J. Agril Res*, 39(3), 407-418.
- Akşit, S. (2007). *Sustainable Tourism in Terms of Natural Environment Awareness* (Unpublished Master's Thesis). Erciyes University, Erciyes.
- Alam, N., Duygun, M., & Ariss, R. T. (2016). Green sukuk: An innovation in Islamic capital markets. In A. B. Dorsman, Ö. Arslan-Ayaydin, & M. B. Karan (Eds.), *Energy and finance* (pp. 167-186). Springer International Publishing.
- Albright, S., Winston, W., & Zappe, C. (2004). *Data analysis for managers with Microsoft Excel*. Thomson Brooks.
- Albritton, D. (1992). Economic issues in global climate change. In J. Reilly & M. Anderson (Eds.), *Global Environmental Change* (Vol. 2, Issue 3, pp. 3–23). Routledge Taylor and Franchise. doi:10.1016/0959-3780(92)90004-Q
- Al-Dhaimesh, O. H., & AlZobi, M. K. (2019). The effect of sustainability accounting disclosures on financial performance: An empirical study on the Jordanian banking sector. *Banks and Bank Systems*, 14(2), 1–8. doi:10.21511/bbs.14(2).2019.01
- Alexopoulos, I., Kounetas, K., & Tzelepis, D. (2018). Environmental and financial performance. Is there a win-win or a win-loss situation? Evidence from the Greek manufacturing. *Journal of Cleaner Production*, 197, 1275–1283. doi:10.1016/j.jclepro.2018.06.302
- Algan, N., & Bayraktar, M. (2018). *Turizm Sektörüne Taşıma Kapasitesi ve Çeşitleri*. ICPESS.
- Ali, A., & Erenstein, O. (2017). Assessing farmer use of climate change adaptation practices and impacts on food security and poverty in Pakistan. *Climate Risk Management*, 16, 183–194. doi:10.1016/j.crm.2016.12.001
- Aliabadi, S., Dorestani, A., & Balsara, N. (2013). The most value relevant accounting performance measure by industry. *Journal of Accounting and Finance*, 13(1987), 22-34.
- Ali, I., Nagalingam, S., & Gurd, B. (2017). Building resilience in SMEs of perishable product supply chains: Enablers, barriers and risks. *Production Planning and Control*, 28(15), 1236–1250. doi:10.1080/09537287.2017.1362487
- Alińska, A., Filipiak, B. Z., & Kosztowniak, A. (2018). The Importance of the Public Sector in Sustainable Development in Poland. *Sustainability*, 10(9), 3278. doi:10.3390/s10093278
- Alinvi, F. (2009). *Customers' expectations of banks becoming cashless-how could banks meet customer's expectations when changing from cash services to deeper customer relationship?* Retrieved in July 20, 2016 from www.divaportal.org/smash/get/diva2:220556/FULLTEXT01.pdf
- Alkan, C. (2015). Sustainable tourism: An application for Alaçatı destination. *Journal of Yaşar University*, 10(40), 6692–6710.
- Allaoui, H., Guo, Y., & Sarkis, J. (2019). Decision support for collaboration planning in sustainable supply chains. *Journal of Cleaner Production*, 229, 761–774. doi:10.1016/j.jclepro.2019.04.367
- Allen, K. (2018, July 3). Countries face higher debt bills due to climate risks. *Financial Times*.
- Alliance of Small Island States (AOSIS). (2008). Proposal to the Ad Hoc Working Group on Long-Term Cooperative Action Under the Convention (AWG-LCA). In *Multi-Window Mechanism to Address Loss and Damage from Climate Change Impacts*. UNFCCC. unfccc.int/files/kyoto_protocol/application/pdf/aosisinsurance061208.pdf

- Alsaifi, K., Elnahass, M., & Salama, A. (2020). Market responses to firms' voluntary carbon disclosure: Empirical evidence from the United Kingdom. *Journal of Cleaner Production*, 262, 1–11. doi:10.1016/j.jclepro.2020.121377
- Al-Salaymeh M (2013). The application of the concept of green marketing in the productive companies from the perspective of workers. *Interdisciplinary Journal of Contemporary Research in Business*, 4(12), 634-641.
- Alsawafi, A., Lemke, F., & Yang, Y. (2020). The impacts of internal quality management relations on the triple bottom line: A dynamic capability perspective. *International Journal of Production Economics*, 232, 107927. doi:10.1016/j.ijpe.2020.107927
- Alshatti, A. S. (2015). *The effect of credit risk management on financial performance of the Jordanian commercial banks*. Academic Press.
- Aluko, A. P., Adebagbo, C. A., & Ukpe, I. E. (2008). Implications of climate change on sustainable forest management in Nigeria. *Journal of Sustainable Environment Management*, (1), 53–58.
- Amanchukwu, R. N. (2015). Climate change education in Nigeria: The role of curriculum review. *Education*, 5(3), 71–79.
- Amasuomo, E., & Baird, J. (2017). Solid waste management trends in Nigeria. *British Journal of Environmental Sciences*, 5(6), 25–37.
- Ambec, S., & Lanoie, P. (2008). Does It Pay to be Green? A Systematic Overview. *The Academy of Management Perspectives*, 22(4), 45–62. doi:10.5465/amp.2008.35590353
- American Marketing Association Dictionary. (n.d.). http://www.marketingpower.com/_layouts/Dictionary.aspx
- Amiruddin, G. P. (2016). Environmental management accounting: Identifying future potentials. *Asia-Pacific Management Accounting Journal*, 11(1), 80–94.
- Ammer, M. A., Aliedan, M. M., & Alyahya, M. A. (2020). Do Corporate Environmental Sustainability Practices Influence Firm Value? The Role of Independent Directors: Evidence from Saudi Arabia. *Sustainability*, 12(22), 9768. doi:10.3390/u12229768
- Amrinder, P. C. S. (2016). A Study of Small and Medium Enterprises (SME) in India on Sustainability Strategy: Highlighting Critical Challenges and Constraints. *Journal of Asia Entrepreneurship and Sustainability*, 12(2), 49.
- Anderson, C. L. (2018). Climate Change and Infrastructure. *Hous. J. Health L. & Pol'y*, 18, 1. PMID:31097909
- Anderson, D. R. (2009). Corporate Survival: The Critical Importance of Sustainability Risk Management. *The Journal of Risk and Insurance*, 76(4), 955–961.
- Anderson, R. (2004). Climbing Mount Sustainability. *Quality Progress*, 37(2), 32–39.
- Andersson, M., Bolton, P., & Samama, F. (2016). Hedging climate risk. *Financial Analysts Journal*, 72(3), 13–32. doi:10.2469/faj.v72.n3.4
- Andrenelli, A., Lejárraga, I., Miroudot, S., & Montinari, L. (2019). *Micro-Evidence on Corporate Relationships in Global Value Chains: The Role of Trade*. FDI and Strategic Partnerships.
- Ansar, A., Caldecott, B., & Tilbury, J. (2013). *Stranded assets and the fossil fuel divestment campaign: What does divestment mean for the valuation of fossil fuel assets?* University of Oxford's Smith School of Enterprise and the Environmental Stranded Assets Programme Working Paper.
- Antipova, T. (2020). Coronavirus Pandemic as Black Swan Event. In *International Conference on Integrated Science* (pp. 356-366). Springer.

Compilation of References

- Anyanwu, C. N., Amadi-Eke, A. S. Nwaka, D. E., Ezeafulukwe, C. F., & Adaka, G. S. (2015). Climate change effects and mitigation strategies on aquaculture: A review. *Agriculture, Forestry and Fisheries*, 4(3-1), 70-72.
- Aphunu, A., & Nwabeze, G. O. (2012). Fish farmers' perception of climate change impact on fish production in Delta State Nigeria. *Journal of Agricultural Extension*, 16(2).
- Apostolopoulos, N., Al-Dajani, H., Holt, D., Jones, P., & Newbery, R. (2018). *Entrepreneurship and the sustainable development goals*. Emerald Publishing Limited. doi:10.1108/S2040-724620188
- Applebaum, K. M., Graham, J., Gray, G. M., LaPuma, P., McCormick, S. A., Northcross, A., & Perry, M. J. (2016). An overview of occupational risks from climate change. *Current Environmental Health Reports*, 3(1), 13–22. doi:10.1007/40572-016-0081-4 PMID:26842343
- Applied Social Psychology (ASP). (2021). *Power in Organizations*. Available at: <https://sites.psu.edu/aspsy/2017/02/22/power-in-organizations/>
- Aragon-Correa, J. A., Martin-Tapia, I., & de la Torre-Ruiz, J. (2015). Sustainability issues and hospitality and tourism firms' strategies. *International Journal of Contemporary Hospitality Management*.
- Aransson, L. (1994). Sustainable Tourism Systems: The Example of Sustainable. Rural Tourism in Sweden. *Journal of Sustainable Tourism*, 2(1-2), 77–92. doi:10.1080/09669589409510685
- Arda, O. A., Bayraktar, E., & Tatoglu, E. (2019). How do integrated quality and environmental management practices affect firm performance? Mediating roles of quality performance and environmental proactivity. *Business Strategy and the Environment*, 28(1), 64–78. doi:10.1002/bse.2190
- Arndt, C., Loewald, C., & Makrelov, K. (2020). *Climate change and its implications for central banks in emerging and developing economies*. Economic Research and Statistics Department, South African Reserve Bank.
- Arnett, D. B., Laverie, D. A., & McLane, C. (2002). Using job satisfaction and pride as internal-marketing tools. *The Cornell Hotel and Restaurant Administration Quarterly*, 43(2), 87–96. doi:10.1177/001088040204300209
- Arora, V., & Lieskovsky, J. (2014). Electricity use as an indicator of US economic activity. Independent Statistics & Analysis. US Energy Information Administration.
- Arrhenius, S. (1896). On the influence of carbonic acid in the air upon the temperature of the ground. *Philosophical Magazine and Journal of Science*, 41(251), 237–276. doi:10.1080/14786449608620846
- Arseculeratne, D., & Yazdanifard, R. (2014). How Green Marketing Can Create a Sustainable Competitive Advantage for a Business. *International Business Research*, 7(1), 130.
- Arslan-Ayaydin, O., & Thewissen, J. (2016). The financial reward for environmental performance in the energy sector. *Energy & Environment*, 27(3-4), 389–413. doi:10.1177/0958305X15627547
- Arumugam, D., & Chirute, T. (2018). Factors determining the adoption of green banking amongst commercial banks in Malaysia. *Electronic Journal of Business & Management*, 5, 50–62.
- Arunrat, N., Wang, C., Pumijumnong, N., Sereenonchai, S., & Cai, W. (2017). Farmers' intention and decision to adapt to climate change: A case study in the Yom and Nan basins, Phichit province of Thailand. *Journal of Cleaner Production*, 143, 672–685. doi:10.1016/j.jclepro.2016.12.058
- Arushanyan, Y., Ekener, E., & Moberg, A. (2017). Sustainability assessment framework for scenarios—SAFS. *Environmental Impact Assessment Review*, 63, 23–34. doi:10.1016/j.eiar.2016.11.001

- Asiedu, B. (2016). Aquaculture in troubled climate: Farmers' perception of climate and their adaptation strategies in Ghana, West Africa. *Journal of Aquaculture Research & Development*, 7(11).
- Association of Nigerian Electricity Distribution Companies. (2016, January 8). Nigeria needs 160,000mw to meet national electricity demands. *The Guardian*. Retrieved from <https://guardian.ng/business-services/nigeria-needs-160000mw-to-meet-national-electricity-demands/>
- Aven, T., Ben-Haim, Y., Boje Andersen, H., Cox, T., Droguett, E. L., Greenberg, M., . . . Thompson, K. M. (2018). *Society for risk analysis glossary*. Society for Risk Analysis.
- Awan, A. (2013). Relationship between Environment and Sustainable Economic Development: A Theoretical Approach to Environmental Problems. *International Journal of Asian Social Sciences*, 3(3), 741–761.
- Axelrod, J. (2019). *Corporate Honesty and Climate Change: Time to Own Up and Act*. Available at: <https://www.nrdc.org/experts/josh-axelrod/corporate-honesty-and-climate-change-time-own-and-act>
- Ayanlade, A., & Ojebisi, S. M. (2019). Climate change impacts on cattle production: Analysis of cattle herders' climate variability/change adaptation strategies in Nigeria. *Change and Adaptation in Socio-Ecological Systems*, 5(1), 12–23. doi:10.1515/cass-2019-0002
- Ayanlade, A., Radeny, M., & Morton, J. F. (2017). Comparing smallholder farmers' perception of climate change with meteorological data: A case study from southwestern Nigeria. *Weather and Climate Extremes*, 15, 24–33. doi:10.1016/j.wace.2016.12.001
- Aykol, B., & Leonidou, L. C. (2015). Researching the green practices of smaller service firms: A theoretical, methodological, and empirical assessment. *Journal of Small Business Management*, 53(4), 1264–1288. doi:10.1111/jsbm.12118
- Azarkamand, S. & Darbra Roman, R.M. (2020). *Climate change and carbon footprint initiatives*. Academic Press.
- Bae, B., & Sami, H. (2005). The effect of potential environmental liabilities on earnings response coefficients. *Journal of Accounting, Auditing & Finance*, 20(1), 43–70. doi:10.1177/0148558X0502000103
- Bagraim, J., Cunningham, P., Potgieter, T., & Viedge, C. (2016). *Organisational Behaviour: A contemporary South African perspective* (4th ed.). Van Schaik Publishers.
- Bahl, S. (2012). Green banking - the new strategic imperative. *Asian Journal f Research in Business Economics and Management*, 2, 176–185.
- Bahri, M. (2020). System Archetypes to understand the impacts of climate change on rice production: A case Study in West Nusa Tenggara, Indonesia. Preprints, 2020040499
- Baldauf, M., Garlappi, L., & Yannelis, C. (2020). Does climate change affect real estate prices? Only if you believe in it. *Review of Financial Studies*, 33(3), 1256–1295. doi:10.1093/rfs/hhz073
- Bali Swain, R., & Yang-Wallentin, F. (2020). Achieving sustainable development goals: Predicaments and strategies. *International Journal of Sustainable Development and World Ecology*, 27(2), 96–106. doi:10.1080/13504509.2019.1692316
- Balyev, V. (2018). *Evaluation of mountaineering sport in terms of tourism effect: The case of Azerbaijan* (Unpublished Master's Thesis). Akdeniz University, Antalya.
- Balvers, R., Du, D., & Zhao, X. (2017). Temperature shocks and the cost of equity capital: Implications for climate change perceptions. *Journal of Banking & Finance*, 77, 18–34. doi:10.1016/j.jbankfin.2016.12.013
- Bammeke, A. O., & Sridhar, M. K. C. (1989). Market wastes in Ibadan, Nigeria. *Waste Management & Research*, 7(2), 115–120. doi:10.1016/0734-242X(89)90056-6

Compilation of References

- Bandura, A. (1982). Self-efficacy mechanism in human agency. *The American Psychologist*, 37(2), 122–147. doi:10.1037/0003-066X.37.2.122
- Banerjee, S. (2001). Corporate environmental strategies and actions. *Management Decision*, 39(1), 36–44. doi:10.1108/EUM000000005405
- Banghøj, J., & Plenborg, T. (2008). Value relevance of voluntary disclosure in the annual report. *Accounting and Finance*, 48(2), 159–180. doi:10.1111/j.1467-629X.2007.00240.x
- Banik, S., Pankaj, P., Naskar, S., Malik, P., Bhatta, R., Takahashi, J., Kohn, R., & Prasad, C. (2015). Climate change: Impacts on livestock diversity in tropical countries. *Livestock Production and Climate Change*, 6, 162–182. doi:10.1079/9781780644325.0162
- Bank of England. (2018). *Transition in thinking: the impact of climate change on the UK banking sector*. Prudential Regulatory Authority (PRA) Report.
- Bankole, A. F., Ayanboye, A. O., Adeosun, O., Osuntade, O. B., & Adelodun, O. B. (2019). Perceived implication of climate change on fish farming ibarapa region of Oyo State. *Nigeria. Asian Journal of Agricultural Extension. Economia e Sociologia*, 31(1), 1–6.
- Banque de France. (2019). Greening the Financial System: The New Frontier. In Banque de France (Ed.), *Banque de France Financial Stability Review* (Vol. 23, Issue June). Banque de France.
- Banwo, A. O., Du, J., & Onokala, U. (2017). The determinants of location specific choice: Small and medium-sized enterprises in developing countries. *Journal of Global Entrepreneurship Research*, 7(1), 1–17. doi:10.1186/40497-017-0074-2
- Barange, M., Bahri, T., Beveridge, M. C. M., Cochrane, K. L., Funge-Smith, S., & Poulain, F. (Eds.). (2018). *Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options*. FAO Fisheries and Aquaculture Technical Paper No. 627. FAO. www.fao.org/3/i9705en/i9705en.pdf
- Baranova, P., & Paterson, F. (2017). Environmental capabilities of small and medium sized enterprises: Towards transition to a low carbon economy in the East Midlands. *Local Economy*, 32(8), 835–853. doi:10.1177/0269094217744494
- Barrett, T., Feola, G., Khusnitdinova, M., & Krylova, V. (2017). Adapting agricultural water use to climate change in a post-Soviet context: Challenges and opportunities in Southeast Kazakhstan. *Human Ecology*, 45(6), 747–762. doi:10.1007/10745-017-9947-9 PMID:29213176
- Basel Committee on Banking Supervision. (2020). *Climate-related financial risks: a survey on current initiatives*. Bank for International Settlements document. www.bis.org
- Batten, S. (2018). *Climate change and the macro-economy: a critical review*. Bank of England Staff Working Paper No. 706.
- Batten, S. (2018). *Climate change and the macro-economy: a critical review*. Bank of England working papers (706).
- Batten, S., Sowerbutts, R., & Tanaka, M. (2016). Let's talk about the weather: The impact of climate change on central banks (No. 603). Bank of England.
- Batten, S., Sowerbutts, R., & Tanaka, M. (2016). *Let's talk about the weather: The impact of climate change on central banks*. Bank of England Staff Working Paper 603.
- Battiston, S., Mandel, A., Monasterolo, I., Schütze, F., & Visentin, G. (2017). A climate stress test of the financial system. *Nature Climate Change*, 7(4), 283–288. doi:10.1038/nclimate3255
- Bauman, A., & Lucy, C. (2019). Enhancing entrepreneurial education: Developing competencies for success. *International Journal of Management Education*, 19(1), 100293. doi:10.1016/j.ijme.2019.03.005

- Bayer, P., Pinkerton, V. M., & Urpelainen, J. (2015). Small and beautiful? The Programme of Activities and the least developed countries. *Climate and Development*, 7(2), 153–164. doi:10.1080/17565529.2014.900471
- Bayon, R., Hawn, A., & Hamilton, K. (2012). *Voluntary carbon markets: An international business guide to what they are and how they work*. Routledge and Taylor & Francis Group.
- Bebbington, J., Russell, S., & Thomson, I. (2017). Accounting and sustainable development: Reflections and propositions. *Critical Perspectives on Accounting*, 48, 21–34. doi:10.1016/j.cpa.2017.06.002
- Begum, M. M., & Momen, M. N. (2021). Global Climate Change and Its. Encyclopedia of Quality of Life and Well-Being Research. doi:10.1007/978-3-319-69909-7
- Beharry-Ramraj, A., & Amolo, J. (2020). *Appraising the Future of Employee Health and Wellness Programmes in the Fourth Industrial Revolution*. Retrieved from: <https://www.igi-global.com/chapter/appraising-the-future-of-employee-health-and-wellness-programmes-in-the-fourth-industrial-revolution/265612>
- Beharry-Ramraj, A., & Amolo, J. (2020). *Changing Skills And Attendant Stressors: Appraising The Efficacy Of Traditional Wellness Programmes In The 4IR*. Available From: <https://www.igi-global.com/chapter/changing-skills-and-attendant-stressors-appraising-the-efficacy-of-traditional-wellness-programmes-in-the-4ir/265614>
- Belás, J., Korauš, M., Kombo, F., & Korauš, A. (2016). Electronic banking security and customer satisfaction in commercial banks. *Journal of Security and Sustainability Issues*, 5(3), 411–422. doi:10.9770/jssi.2016.5.3(9)
- Bellarby, J., Tirado, R., Leip, A., Weiss, F., Lesschen, J. P., & Smith, P. (2013). Livestock greenhouse gas emissions and mitigation potential in Europe. *Global Change Biology*, 19(1), 3–18. doi:10.1111/j.1365-2486.2012.02786.x PMID:23504717
- Belleflamme, P., Lambert, T., & Schwienbacher, A. (2014). Crowdfunding: Tapping the right crowd. *Journal of Business Venturing*, 29(5), 585–609. doi:10.1016/j.jbusvent.2013.07.003
- Belvedere, V., & Grando, A. (2017). *Sustainable Operations and Supply Chain Management*. Wiley. doi:10.1002/9781119383260
- Belz, F. M., & Peattie, K. (2009). *Sustainability marketing: A global perspective*. Wiley.
- Benami, E., & Carter, M. R. (2021). Can digital technologies reshape rural microfinance? Implications for savings, credit, & insurance. *Applied Economic Perspectives and Policy*, aapp.13151. doi:10.1002/aapp.13151
- Berchicci, L. (2014). Innovating for sustainability. In *Chemistry & Industry* (Vol. 78, Issue 1). doi:10.1002/cind.781_6.x
- Bergland, H., Clark, D. J., & Pedersen, P. A. (2001). Rent Seeking and the Regulation of a Natural Resource. *Marine Resource Economics*, 16, 219-233. Retrieved from <https://www.jstor.org/stable/42629320?seq=1>
- Berkhout, F., Hertin, J., & Gann, D. M. (2006). Learning to adapt: Organisational adaptation to climate change impacts. *Climatic Change*, 78(1), 136. doi:10.1007/10584-006-9089-3
- Bermejo, Arto, & Hoyos. (2014). Sustainable Development in the Brundtland Report and Its Distortion: Implications for Development Economics and International Cooperation. In *Development Cooperation: Facing the Challenges of Global Change*. University of Nevada Press.
- Bernstein A. Koudijs P. (2020). Mortgage Amortization and Wealth Accumulation. SSRN 3569252.
- Bernstein, W. J. (2013). *Deep Risk: How History Informs Portfolio Design*. Efficient Frontier Publications.

Compilation of References

- Bethel, J. W., Spector, J. T., & Krenz, J. (2017). Hydration and cooling practices among farmworkers in Oregon and Washington. *Journal of Agromedicine*, 22(3), 222–228. doi:10.1080/1059924X.2017.1318100 PMID:28402203
- Bettley, A., & Burnley, S. (2008). Towards Sustainable Operations Management Integrating Sustainability Management into Operations Management Strategies and Practices. In K. B. Misra (Ed.), *Handbook on Performability Engineering* (pp. 875–904). Springer-Verlag. doi:10.1007/978-1-84800-131-2_53
- Bhattacharyya, P., & Barman, D. (2018). Crop residue management and greenhouse gases emissions in tropical rice lands. In *Soil management and climate change* (pp. 323–335). Academic Press. doi:10.1016/B978-0-12-812128-3.00021-5
- Bhattarai, Y. R. (2016). Effect of Credit Risk on the Performance of Nepalese Commercial Banks. *International Journal of Accounting & Finance Review*.
- Bhatti, K. K. (2016). Green marketing: Savior for the consumers, businesses and the world. *International Journal of Emerging Research in Management & Technology*, 5(6), 70–76.
- Bhuiyan, A.B., Ali, M.J., Kassim, A.A.M., Alias, Z., & Munir, A.N. (2020). *Mission Drift and Sustainability of the Microfinance Institutions: A Methodological Review*. Academic Press.
- Bibri, S. E., & Krogstie, J. (2017). Smart sustainable cities of the future: An extensive interdisciplinary literature review. *Sustainable Cities and Society*, 31, 183–212. doi:10.1016/j.scs.2017.02.016
- Biggeri, M., Anand, P. B., Fennell, S., & Comim, F. (2020 forthcoming). *Small and medium enterprises and industrial clusters in BRICS countries*. In *Handbook of BRICS and emerging economies*. Oxford University Press.
- Bisbis, M. B., Gruda, N., & Blanke, M. (2018). Potential impacts of climate change on vegetable production and product quality – A review. *Journal of Cleaner Production*, 170, 1602–1620. doi:10.1016/j.jclepro.2017.09.224
- Biswakarma, G. (2017). Sustainability and green banking practices: Understanding the strategic convergence in Nepalese banks- sem approach. *European Journal of Management*, 17(2), 251–265. doi:10.18374/EJM-17-2.3
- Blaum, D., Griffin, T. D., Wiley, J., & Britt, M. A. (2017). Thinking about global warming: Effect of policy-related documents and prompts on learning about causes of climate change. *Discourse Processes*, 54(4), 303–316. doi:10.1080/00163853X.2015.1136169
- Blight, J., & De Wit, M. (2004). *Sustainable options*. UCT Press.
- Bloomberg New Energy Finance. (2020, October). Green to power to draw \$11 trillion investments by 2050. *Bloomberg*. Retrieved from <https://www.bloomberg.com/news/articles/2020-10-27/green-power-to-draw-11-trillion-investment-by-2050-bnef-says>
- Bloomberg. (2020). *EU Carbon Market Has Chance to Link With U.K. After Brexit Deal*. Retrieved from <https://www.bloomberg.com/news/articles/2020-12-28/eu-carbon-market-has-chance-to-link-with-u-k-after-brex-it-deal>
- BNRCC (Building Nigeria's Response to Climate Change). (2011). *National adaptation strategy and plan of action on climate change for Nigeria (NASPA-CCN)*. Prepared for the Federal Ministry of Environment Special Climate Change Unit.
- Bocken, N. M. (2015). Sustainable venture capital—catalyst for sustainable start-up success? *Journal of Cleaner Production*, 108, 647–658. doi:10.1016/j.jclepro.2015.05.079
- Bodansky, D., Brunnée, J., & Rajamani, L. (2017). *International climate change law*. Oxford University Press.
- Bolton, P., Després, M., da Silva, L. A. P., Samama, F., & Svartzman, R. (2020). *The green swan: Central banking and financial stability in the age of climate change*. Bank for International Settlements.

- Bolton, P., Despres, M., Pereira da Silva, L., Samama, F., & Svartzman, R. (2020). *The green swan: central banking and financial stability in the age of climate change*. Bank for International Settlements.
- Borokini, T. I., Babalola, F. D., Amusa, T. O., Ivande, S. T., Wala, Z. J., Jegede, O. O., Tanko, D., & Ihuma, J. O. (2012). Community Based Forest Resources Management in Nigeria: Case Study of of Ngel Nyaki Forest Reserve, Mambilla Plateau, Taraba State, Nigeria. *Journal of Tropical Forestry and Environment*, 2(1), 69–76. doi:10.31357/jtfe.v2i1.571
- Bose, S., Saha, A., Khan, H. Z., & Islam, S. (2017). Non-financial disclosure and market-based firm performance: The initiation of financial inclusion. *Journal of Contemporary Accounting & Economics*, 13(3), 263–281. doi:10.1016/j.jcae.2017.09.006
- Bos, K., & Gupta, J. (2019). Stranded assets and stranded resources: Implications for climate change mitigation and global sustainable development. *Energy Research & Social Science*, 56, 101215. doi:10.1016/j.erss.2019.05.025
- Boustan, L., Kahn, M., Rhode, P., & Yanguas, M. (2020). The effect of natural disasters on economic activity in US countries: A century of data. *Journal of Urban Economics*, 118, 103257. doi:10.1016/j.jue.2020.103257
- Bovari, E., Giraud, G., & Mc Isaac, F. (2018). Coping with collapse: A stock-flow consistent monetary macrodynamics of global warming. *Ecological Economics*, 147, 383–398. doi:10.1016/j.ecolecon.2018.01.034
- BPS-Statistic Indonesia. (2021). *Statistical Yearbook of Indonesia 2021*. Author.
- Brack, D. (2019). Forests and Climate Change. *The fourteenth session of the United Nations Forum on Forests*.
- Bradley, H., & Nicole, F. (2018). Climate Change is Forcing the Insurance Industry to Recalculate. *The Wall Street Journal*. <https://www.wsj.com/graphics/climate-change-forcing-insuranceindustry-recalculate/>
- Bradlow, D. (2019, September). Central banks are waking up to climate change dangers. It's about time. *The Conversation*. <https://theconversation.com/central-banks-are-waking-up-to-climate-change-dangers-its-about-time-122204>
- Brady, D. (2007, June 11). Pepsi: Repairing a Poisoned Reputation in India. *Business Week*, 46-54.
- Brainard, L. (2019). *Why climate change matters for monetary policy and financial stability*. In *Research conference "The Economics of Climate Change"*. Federal Reserve Bank of San Francisco.
- Breshears, D. D., Huxman, T. E., Adams, H. D., Zou, C. B., & Davison, J. E. (2008). Vegetation synchronously leans upslope as climate warms. *Proceedings of the National Academy of Sciences of the United States of America*, 105(33), 11591–11592. doi:10.1073/pnas.0806579105 PMID:18697950
- Brewster, C. (2017). The integration of human resource management and corporate strategy. *Policy and Practice in European Human Resource Management*, 22-35.
- Bright, D. S., Fry, R. E., & Cooperrider, D. L. (2006). Transformative innovations for the mutual benefit of business society, and environment. *BAWB Interactive Working Paper Series*, 1(1), 17-31.
- BRITA UK. (2019). *British SMEs struggling to reduce single-use plastics, survey finds*. <https://www.medicalplasticsnews.com/news/british-smes-struggling-to-reduce-single-use-plastics-survey/>
- Bruno, J. F., Bates, A. E., Cacciapaglia, C., Pike, E. P., Amstrup, S. C., Van Hooideonk, R., Henson, S. A., & Aronson, R. B. (2018). Climate change threatens the world's marine protected areas. *Nature Climate Change*, 8(6), 499–503. doi:10.1038/41558-018-0149-2
- Bruyninckx, H. (2019). *A healthy environment is an obligations for sustainable economy and a fair society*. <https://www.eea.europa.eu/tr/articles/saglikli-cevre-surdurulebilir-ekonomi-ve>

Compilation of References

- Bryan, M. F. (2020). On the Origin and Evolution of the Word Inflation. In *Handbook of Monetary Policy* (pp. 593–599). Routledge. doi:10.4324/9780429270949-44
- Buallay, A. (2019). Is sustainability reporting (ESG) associated with performance? Evidence from the European banking sector. *Management of Environmental Quality*, 30(1), 98–115. doi:10.1108/MEQ-12-2017-0149
- Buana, G. K., & Musari, K. (2020, December 28). A new sphere of sukuk: Linking pandemic to Paris agreement. *The World Financial Review, Finance and Banking*. Retrieved from <https://worldfinancialreview.com/a-new-sphere-of-sukuk-linking-the-pandemic-to-the-paris-agreement/>
- Bui, B., & De Villiers, C. (2017). Business strategies and management accounting in response to climate change risk exposure and regulatory uncertainty. *The British Accounting Review*, 49(1), 4–24. doi:10.1016/j.bar.2016.10.006
- Bukhari, S. A. A., Hashim, F., Amran, A. B., & Hyder, K. (2019). Green Banking and Islam: Two sides of the same coin. *Journal of Islamic Marketing*, 11(4), 977–1000. doi:10.1108/JIMA-09-2018-0154
- Bunten, D., & Kahn, M. E. (2017). Optimal real estate capital durability and localized climate change disaster risk. *Journal of Housing Economics*, 36, 1–7. doi:10.1016/j.jhe.2017.01.004
- Burke, M., & Emerick, K. (2016). Adaptation to climate change; Evidence from US agriculture. *American Economic Journal*, 8(3), 106–140. doi:10.1257/pol.20130025
- Burke, M., Hsiang, S. M., & Miguel, E. (2015). Global non-linear effect of temperature on economic production. *Nature*, 527(7577), 235–239. doi:10.1038/nature15725 PMID:26503051
- Burnham, M., & Ma, Z. (2017). Climate change adaptation: Factors influencing Chinese smallholder farmers' perceived self-efficacy and adaptation intent. *Regional Environmental Change*, 17(1), 171–186. doi:10.1007/10113-016-0975-6
- Burns, M., & Weaver, A. (2008). *Exploring sustainability science: A Southern African perspective*. Council for Scientific and Industrial Research.
- Busby, J. (2018). Warming world: Why climate change matters more than anything else. *Foreign Affairs*, 97, 49.
- Busch, T., & Lewandowski, S. (2018). Corporate carbon and financial performance: A meta-analysis. *Journal of Industrial Ecology*, 22(4), 745–759. doi:10.1111/jiec.12591
- Buyukozkan, G., Kayakutlu, G., & Karakadilar, I. S. (2015). Assessment of lean manufacturing effect on business performance using Bayesian Belief Networks. *Expert Systems with Applications*, 42(19), 6539–6551. doi:10.1016/j.eswa.2015.04.016
- Cadez, S., & Guilding, C. (2017). Examining distinct carbon cost structures and climate change abatement strategies in CO2 polluting firms. *Accounting, Auditing & Accountability Journal*, 30(5), 1041–1064. doi:10.1108/AAAJ-03-2015-2009
- Cahan, S. F., de Villiers, C., Jeter, D. C., Naiker, V., & van Staden, C. J. (2016). Are CSR disclosures value relevant? Cross-country evidence. *European Accounting Review*, 25(3), 579–611. doi:10.1080/09638180.2015.1064009
- Caldecott, B., Howarth, N., & McSharry, P. (2013). *Stranded assets in agriculture: protecting value from environment-related risks*. Smith School of Enterprise and Environment Working Paper.
- Caldecott, B., Harnett, E., Cojoianu, T., Kok, I., & Pfeiffer, A. (2016). *Stranded Assets: A Climate Risk Challenge*. Inter-American Development Bank.
- Caldecott, B., Harnett, E., Cojoianu, T., Kok, I., & Pfeiffer, A. (2016). *Stranded assets: a climate risk challenge*. Inter-American Development Bank. doi:10.18235/0000517

- Çalık, A. Ö. (2014). *The social carrying capacity of touristic centers: Beypazarı case study* (Unpublished Doctoral Thesis). Gazi University, Ankara.
- Callenbach, E., Capra, F., Goldman, L., Lutz, R., & Marburg, S. (1993). *Eco-Management: The Elmwood Guide to Ecological Auditing and Sustainable Business*. Berrett-Koehler.
- Camacho, A. E., Kelly, M. L., Marantz, N. J., & Weil, G. (2019). Mitigating Climate Change Through Transportation and Land Use Policy. *Envtl. L. Rep. News & Analysis*, 49, 10473.
- Cameron, E., & Green, M. (2015). *Making sense of change management* (4th ed.). CPI Group (UK) Ltd.
- Cameron, K. S. (2003). *Organizational virtuousness and performance*. Academic Press.
- Cameron, D. B., & Caza, A. (2004). Exploring the relationships between organizational virtuousness and performance. *The American Behavioral Scientist*, 47(6), 766–790. doi:10.1177/0002764203260209
- Camilleri, M., Jaques, R., & Isaacs, N. (2001). *Climate change impacts on building performance*. Retrieved from <https://www.irbnet.de/daten/iconda/CIB3008.pdf>
- Campbell, A. F. (2017). *All the relief money in the world won't rebuild Houston. Undocumented workers will*. Available at: <http://www.Vox.com>
- Can, M. D. (2008). *Sürdürülebilir Turizm ve Turizm Çeşitliliği Kapsamında Kültür ve Turizm Koruma ve Gelişim Bölgeleri: Mersin-Tarsus Örneği* (Doctorate Thesis). Republic of Turkey Ministry of Culture and Tourism, Ankara.
- Canaan, S. P. (2011). *The Determinants of Expansion of SMEs*. The Economic Research Forum.
- Can, E. (2013). Evaluation of Sustainable Tourism in Tourism Destinations in Terms of Sustainable Competitiveness. *Istanbul Journal of Social Sciences*, 4, 23–40.
- Carbon Disclosure Project (CDP). (2019). *World's biggest companies face \$1 trillion in climate change risks*. Available at <https://www.cdp.net/en/research/global-reports/global-climate-change-report-2018>
- Cardenas, V., Hochrainer, S., Mechler, R., Pflug, G., & Linnerooth-Bayer, J. (2007). Sovereign financial disaster risk management: The case of Mexico. *Environmental Hazards*, 7(1), 40–53. doi:10.1016/j.envhaz.2007.04.005
- Carleton, T.A. & Hsiang, S. (2016). Social and economic impacts of climate. *Science*, 353(6304), 1112.
- Carlsson-Szlezak, P., Reeves, M., & Swartz, P. (2020). What coronavirus could mean for the global economy. *Harvard Business Review*, 3, 1–10.
- Carney, M. (2015). *Breaking the Tragedy of the Horizon—climate change and financial stability*. Speech given at Lloyd's of London.
- Carney, M. (2015). *Breaking the tragedy of the horizon—Climate change and financial stability*. Speech given on Lloyd's of London by the governor of the Bank of England. Available from: <https://www.bankofengland.co.uk/publications/Pages/speeches/2015/544.aspx>
- Carney, M. (2019). *A transition in thinking and action*. Remarks at international climate risk conference for supervisors. <https://www.bankofengland.co.uk>
- Carter, M., De Janvry, A., Sadoulet, E., & Sarris, A. 2014. Index-based weather insurance for developing countries: A review of evidence and a set of propositions for up-scaling. *Development Policies Working Paper*, 111.
- Carter, K., & Moir, S. (2012). Diagrammatic representations of sustainability—a review and synthesis. *Proceedings of the 28th annual ARCOM conference*, 1479–1489.

Compilation of References

- Causevic, A., & Selvakkumaran, S. (2018). The role of multilateral climate funds in urban transitions between 1994 and 2014. *Journal of Sustainable Finance & Investment*, 8(3), 275–299. doi:10.1080/20430795.2018.1465769
- Cazenave, A., & Cozannet, G. L. (2014). Sea level rise and its coastal impacts. *Earth's Future*, 2(2), 15–34. doi:10.1002/2013EF000188
- Ceballos, A., Dresdner-Cid, J. D., & Quiroga-Suazo, M. (2018). Does the location of salmon farms contribute to the reduction of poverty in remote coastal areas? An impact assessment using a Chilean case study. *Food Policy*, 75, 68–79. doi:10.1016/j.foodpol.2018.01.009
- Çelik, N. (2014). *The effects of sustainable tourism practices on tourism demand: The case of Muğla* (Unpublished Master's Thesis). Muğla Sıtkı Koçman University, Muğla.
- Centre for Environmental Right (CfER). (2019). *The Truth about South African Banks and Companies and their ability to address climate change risk-Full Disclosure 5*. Retrieved on 21/01/21 cer.org.za
- Cerchione, R., & Bansal, H. (2020). Measuring the impact of sustainability policy and practices in tourism and hospitality industry. *Business Strategy and the Environment*, 29(3), 1109–1126.
- Ceres. (2018). *Ceres*. <https://www.ceres.org/>
- Çeti, B. (2018). Evaluating the Concept of Carrying Capacity in the Context of Tourism Policy and Planning. *Journal of Business Management and Economic Research*, 1, 1–17. doi:10.29226/TR1001.2018.84
- Chams, N., & García-Blandón, J. (2019). On the importance of sustainable human resource management for the adoption of sustainable development goals. *Resources, Conservation and Recycling*, 141, 109–122. doi:10.1016/j.resconrec.2018.10.006
- Chan, E. S., & Hawkins, R. (2010). Attitude towards EMSs in an international hotel: An exploratory case study. *International Journal of Hospitality Management*, 29(4), 641–651. doi:10.1016/j.ijhm.2009.12.002
- Chan, E. S., Okumus, F., & Chan, W. (2020). What hinders hotels' adoption of environmental technologies: A quantitative study. *International Journal of Hospitality Management*, 84, 102324.
- Change, I. P. O. C. (2007). Climate change 2007: The physical science basis. *Agenda (Durban, South Africa)*, 6(07), 333.
- Chan, W. W., & Lam, J. (2001). Environmental accounting of municipal solid waste originating from rooms and restaurants in the Hong Kong hotel industry. *Journal of Hospitality & Tourism Research (Washington, D.C.)*, 25(4), 371–385.
- Chassé, S., & Boiral, O. (2017). Legitimizing corporate (un) sustainability: A case study of passive SMEs. *Organization & Environment*, 30(4), 324–345. doi:10.1177/1086026616672065
- Chemical industries association. (2015). *Safeguarding chemical businesses in a changing climate. How to prepare a climate change adaptation plan?* Retrieved from <https://www.cia.org.uk/LinkClick.aspx?fileticket=KW8WF8CBZG0%3D&portalid=0>
- Chen, M. F. (2020). Effects of psychological distance perception and psychological factors on pro-environmental behaviors in Taiwan: Application of construal level theory. *International Sociology*, 35(1), 70–89. doi:10.1177/0268580919881870
- Chen, S., & Gong, B. (2021). Response and adaptation of agriculture to climate change: Evidence from China. *Journal of Development Economics*, 148, 102557. doi:10.1016/j.jdevco.2020.102557
- Chersich, M. F., & Wright, C. Y. (2019). Climate change adaptation in South Africa: A case study on the role of the health sector. *Globalization and Health*, 15(1), 22. doi:10.1186/12992-019-0466-x PMID:30890178

- Chester, M. V., Underwood, B. S., & Samaras, C. (2020). Keeping infrastructure reliable under climate uncertainty. *Nature Climate Change*, 1–3.
- Chevalier, R. (2010). Integrating adaptation into developmental strategies: The Southern African perspective. In S. Bauer & I. Scholz (Eds.), *Adaptation to climate change in southern Africa: New boundaries for development* (pp. 191–192). Earthscan.
- Chijioke, O. B., Haile, M., & Waschkeit, C. (2011). *Implication of climate change on crop yield and food accessibility in Sub-Saharan Africa, Interdisciplinary Term Paper ZEF Doctoral Studies Program*. Center for Development Research, University of Bonn.
- Chinedu, I., Ezeibe, C., Anijiofor, S., & Daud, N. (2018). Solid waste management in Nigeria: Problems, prospects, and policies. *Journal of Solid Waste Technology Management*, 44(2), 163–172. doi:10.5276/JSWTM.2018.163
- Chinomona, E., & Maziriri, E. T. (2015). Women in action: Challenges facing women entrepreneurs in the Gauteng Province of South Africa. *International Business & Economics Research Journal*, 14(6), 835–850. doi:10.19030/iber.v14i6.9487
- Chinowsky, P. S., Schweikert, A. E., Strzepek, N. L., & Strzepek, K. (2015). Infrastructure and climate change: A study of impacts and adaptations in Malawi, Mozambique, and Zambia. *Climatic Change*, 130(1), 49–62. doi:10.1007/10584-014-1219-8
- Chirambo, D. (2017). Enhancing climate change resilience through microfinance: Redefining the climate finance paradigm to promote inclusive growth in Africa. *Journal of Developing Societies*, 33(1), 150–173. doi:10.1177/0169796X17692474
- Chirambo, D. (2018). Towards the achievement of SDG 7 in sub-Saharan Africa: Creating synergies between Power Africa, Sustainable Energy for All and climate finance in-order to achieve universal energy access before 2030. *Renewable & Sustainable Energy Reviews*, 94, 600–608. doi:10.1016/j.rser.2018.06.025
- Cho, R. (2019, June). How Climate Change Impacts the Economy. *State of the Planet*. <https://blogs.ei.columbia.edu/2019/06/20/climate-change-economy-impacts/>
- Cholasseri, S. (2016). Green banking –an overview. *International Journal of Advance Research and Innovative Ideas in Education*, 1(4), 108–111.
- Christensen, J. H., Hewitson, B., Busuioc, A., Chen, A., Gao, X., Held, I., Jones, R., Kolli, R. K., Kwon, W. T., Laprise, R., Magaña Rueda, V., Mearns, L., Menéndez, C. G., Räisänen, J., Rinke, A., Sarr, A., & Whetton, P. (2007). Regional climate projections. In S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor, & H. L. Miller (Eds.), *Climate change 2007: The physical science basis. contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press.
- Christensen, P. H. (2017). A post-global financial crisis (GFC) framework for strategic planning, assessment and management decision making for US sustainable commercial real estate. *Journal of Property Investment & Finance*, 35(6), 589–618. doi:10.1108/JPIF-11-2016-0085
- Christ, K. L., & Burritt, R. (2017). Material flow cost accounting for food waste in the restaurant industry. *British Food Journal*, 119(3), 600–612.
- Christ, K. L., & Burritt, R. L. (2013). Environmental management accounting: The significance of contingent variables for adoption. *Journal of Cleaner Production*, 41, 163–173.
- Christmann, P. (2000). Effects of best practices of environmental management on cost advantage: The role of complementary assets. *Academy of Management Journal*, 43(4), 663–680.

Compilation of References

- Christophers, B. (2019). Environmental beta or how institutional investors think about climate change and fossil fuel risk. *Annals of the Association of American Geographers*, 109(3), 754–774. doi:10.1080/24694452.2018.1489213
- CIFOR. (n.d.). *Forests and climate change*. www.cifor.org/forests-and-climate-change
- Clarke, K. & O'Neill, S. (2005). Is the environmental professional... an accountant? *Greener Management International*, (49).
- Clean. (2021). *Human activities are impacting the climate system*. https://cleanet.org
- Clemencon, R. (2016). The two sides of the Paris Climate Agreement: Dismal Failure or Historic Breakthrough? *Journal of Environment & Development*, 25(1), 3–24. doi:10.1177/1070496516631362
- Cliffe, D. (2014). Best Practices for When s* IT Hits the Fan. 9. In *Climate change and human health: Risks and responses*. World Health Organization.
- Climatechange. (2020). *What is a Carbon Footprint?* http://climatechange.boun.edu.tr/ekolojik-ayak-izi-nedir/
- Climefish. (2020). *Climate Change and Impacts on Aquaculture*. https://climefish.eu
- Colacito, R., Hoffman, B., & Phan, T. (2018). *Temperature and growth: A panel analysis of the United States*. WP 19-09.
- Colas, J., Khaykin, I., & Pyanet, A. (2020, September 21). Climate Change Will Restructure the Economy: Here's How Banks Can Prepare. *Brink News*. https://www.brinknews.com/how-banks-can-manage-climate-risk/
- Collier, P., Conway, G., & Venables, T. (2008). Climate change and Africa. *Oxford Review of Economic Policy*, 24(2), 337–353. doi:10.1093/oxrep/grn019
- Combs, J., Liu, Y., Hall, A., & Ketchen, D. (2006). How much do high-performance work practices matter? A meta-analysis of their effects on organizational performance. *Personnel Psychology*, 59(3), 501–528. doi:10.1111/j.1744-6570.2006.00045.x
- Comgate Engineering Ltd. (2008). *Risk Management*. Retrieved from: http://www.comgate.com/riskmgmt/risk.html
- Commission Regulation (EU) No 1031/2010 of 12 November 2010 on the timing, administration and other aspects of auctioning of greenhouse gas emission allowances pursuant to Directive 2003/87/EC of the European Parliament and of the Council establishing a scheme for greenhouse gas emission allowances trading within the Community. OJ L 302, 18.11.2010, 1-41.
- Contreras, G., Bos, J. W. B., & Kleimeier, S. (2019). Self-regulation in sustainable finance: The adoption of the Equator Principles. *World Development*, 122, 306–324. doi:10.1016/j.worlddev.2019.05.030
- Conway, D., Nicholls, R., Brown, S., Tebboth, M., Adger, W., Ahmad, B., Biemans, H., Crick, F., Lutz, A. F., De Campos, R. S., Said, M., Singh, C., Zaroug, M. A. H., Ludi, E., New, M., & Wester, P. (2019). The need for bottom-up assessments of climate risks and adaptation in climate-sensitive regions. *Nature Climate Change*, 9(7), 503–511. doi:10.1038/41558-019-0502-0
- Cook, J., Oreskes, N., Doran, P., Anderegg, W., Verheggen, B., Maibach, E. W., Carlton, J. S., Lewandowsky, S., Skuce, A. G., Green, S. A., Nuccitelli, D., Jacobs, P., Richardson, M., Winkler, B., Painting, R., & Rice, K. (2015). Consensus on consensus: A synthesis of consensus estimated on human-caused global warming. *Environmental Research Letters*, 11(4), 048002. doi:10.1088/1748-9326/11/4/048002
- Cooper, S., Grubb, M., Rysanek, A., & Laing, T. (2011). *Revenue dimensions of the EU ETS Phase III. Climate Strategies*. Retrieved from https://climatestrategies.org/wp-content/uploads/2011/05/cs-revenues-phaseiii-final.pdf

- Coppola, M., Krick, T., & Blohmke, J. (2019). *Companies are under pressure on climate change and need to do more: Feeling the heat?* Retrieved from <https://www2.deloitte.com/us/en/insights/topics/strategy/impact-and-opportunities-of-climate-change-on-business.html>
- Cornelissen. (2008). Promoting Sustainable Consumer Behaviour by Cueing Common Environmental Behaviours as Environmental. *International Journal of Research in Marketing*, 25(1), 46-55.
- Costanza, R., Cumberland, J., Daly, H., Goodland, R., & Norgaard, R. (1997). *An Introduction to Ecological Economics*. CRC Press. doi:10.1201/9781003040842
- Costello, M. (2008). 13 Steps to Green Your Business. *Business and Economic Review*, 54(4), 6–9.
- Council on Foreign Relations. (2009). *Deforestation and Greenhouse Gas Emissions*. <https://www.cfr.org>
- Coviello, N. E., & Jones, M. V. (2014). Methodological issues in international entrepreneurship research. *Journal of Business Venturing*, 19(4), 485–508. doi:10.1016/j.jbusvent.2003.06.001
- CPF. (2008). *Strategic framework for forests and climate change. A proposal by the CPF for a coordinated forest-sector response to climate change*. Collaborative Partnership on Forests.
- Cramer, C., Sender, J., & Oqubay, A. (2020). *African economic development: Evidence, theory, policy*. Oxford University Press. doi:10.1093/oso/9780198832331.001.0001
- Cramer, W., Guiot, J., Fader, M., Garrabou, J., Gattuso, J. P., Iglesias, A., Lange, M. A., Lionello, P., Llasat, M. C., Paz, S., Peñuelas, J., Snoussi, M., Toreti, A., Tsimplis, M. N., & Xoplaki, E. (2018). Climate change and interconnected risks to sustainable development in the Mediterranean. *Nature Climate Change*, 8(11), 972–980. doi:10.1038/41558-018-0299-2
- Crecente, F., Sarabia, M., & del Val, M. T. (2020). Climate change policy and entrepreneurial opportunities. *Technological Forecasting and Social Change*.
- Crichton, R., Walker, T., & Patel, A. (2018). Slowing climate change: Mitigating poverty and environmental degradation via strategic human resource management and responsible leadership. In *CSR and Climate Change Implications for Multinational Enterprises*. Edward Elgar Publishing. doi:10.4337/9781786437761.00010
- Crimmins, A., Bell, J., Fann, N., & Hawkins, M. (2016). *The impacts of climate change on human health in the United States: A Scientific Assessment*. Retrieved from <https://health2016.globalchange.gov/>
- Crotty, J., & Rodgers, P. (2012). Sustainable development in the Russia Federation: The limits of greening within industrial firms. *Corporate Social Responsibility and Environmental Management*, 19(3), 178–190. doi:10.1002/csr.263
- Crouch, I. G., & Ritchie, B. (1999). Brent, Tourism, Competitiveness and Social Prosperity. *Journal of Business Research*, 44(1), 137–152. doi:10.1016/S0148-2963(97)00196-3
- Crutzen, P. J., & Eugene, F. S. (2000). The “Anthropocene.”. *Global Change Newsletter*, (41), 17–18. https://placesjournal.org/article/landscape-migration/?gclid=cj0kcqiaj9ibbhjarisae9qrtaj5bzhcwoq6n5xhzxhk_fd9kgcssx07_2o5vw7cpf99vxaqls_9iaaqqzealw_wcb
- Cui, Y., Geobey, S., Weber, O., & Lin, H. (2018). The impact of green lending on credit risk in China. *Sustainability*, 2018(6), 10. doi:10.3390/u10062008
- Cummins, D., & Mahul, O. (2008). *Catastrophe Risk Financing in Developing Countries: Principles for Public Intervention*. World Bank. doi:10.1596/978-0-8213-7736-9

Compilation of References

- Curphey, M. (2019). *Industries most vulnerable to climate change. Global warming and climate change pose a seemingly ever-increasing global risk, but can the damage be repaired or even halted?* Retrieved from <https://csuite.raconteur.net/business-risk/industries-most-vulnerable-to-climate-change/>
- Cutovoi, I. T. M. (2020). Stakeholders Engaged in Creating Sustainable Value (CVS) and Innovation. *Global Journal of Management and Business Research*.
- Dabbadie, L., Aguilar-Manjarrez, J., Beveridge, M. C. M., Bueno, P. B., Ross, L. G., & Soto, D. (2018). Effects of climate change on aquaculture: drivers, impacts and policies. In M. Barange, T. Bahri, M. Beveridge, K. Cochrane, S. Funge-Smith, & F. Poulain (Eds.), *Impacts of Climate Change on Fisheries and Aquaculture: Synthesis of Current Knowledge, Adaptation and Mitigation Options*. FAO Fisheries Technical Paper 627. www.fao.org/3/i9705en/i9705en.pdf
- Dafermos, Y., Nikolaidi, M., & Galanis, G. (2017). A stock-flow fund ecological macro-economic model. *Ecological Economics*, 131, 191–207. doi:10.1016/j.ecolecon.2016.08.013
- Dafermos, Y., Nikolaidi, M., & Galanis, G. (2018). Climate change, financial stability and monetary policy. *Ecological Economics*, 152, 219–234. doi:10.1016/j.ecolecon.2018.05.011
- Daft, R. (2011). *The Leadership Experience* (5th ed.). South Western: Cengage.
- Dahlstrom, R. (2010). *Green Marketing Management*. South Western Centage Learning Press.
- Daily, B. F., Bishop, J. W., & Govindarajulu, N. (2009). A conceptual model for organizational citizenship behavior directed toward the environment. *Business & Society*, 48(2), 243–256. doi:10.1177/0007650308315439
- Daily, B. F., Bishop, J. W., & Massoud, J. A. (2012). The role of training and empowerment in environmental performance. *International Journal of Operations & Production Management*, 32(5), 631–647. doi:10.1108/01443571211226524
- Daioglou, V., Muratori, M., Lamers, P., Fujimori, S., Kitous, A., Köberle, A. C., & Mima, S. (2020). Implications of climate change mitigation strategies on international bioenergy trade. *Climatic Change*, 163(3), 1639–1658. doi:10.1007/10584-020-02877-1
- Dalhaus, T., Musshoff, O., & Finger, R. (2018). Phenology information contributes to reduce temporal basis risk in agricultural weather index insurance. *Scientific Reports*, 8(1), 1–10. doi:10.1038/41598-017-18656-5 PMID:29311587
- Dall’Aglia, C., Hayati, F., & Lee, D. (2020). *Measuring the Biases, Burdens, and Barriers Women Entrepreneurs Endure in Myanmar*.
- Daly, H. (1996). *Beyond Growth*. Beacon Press.
- Danielsen, R., & Agnarsson, S. (2020). In Pursuit of the Three Pillars of Sustainability in Fisheries: A Faroese Case Study. *Marine Resource Economics*, 35(2), 177–193. doi:10.1086/708245
- Darnall, N., Jolley, G., & Handfield, R. (2008). Environmental Management Systems and Green Supply Chain Management: Complements for Sustainability? *Business Strategy and the Environment*, 18(1), 30–45. doi:10.1002/bse.557
- Dash, B. M., & Das, S. M. (2012). Green marketing strategies for sustainable business growth. *Journal of Business Management & Social Sciences Research*, 1, 82–87.
- Dastak, A. G., & Aligholi, M. (2014). Investigation of the impact of marketing mix (8p) on insurance policy purchase in Mellat Insurance Company in Alborz Province, Iran. *Journal of Applied Environmental and Biological Sciences*, 4(11), 100–106.
- Dauda, A. B., Folorunso, L. A., & Dasuki, A. (2013). Use of Probiotics for Sustainable Aquaculture Production in Nigeria. *Journal of Agriculture and Social Research*, 13, 35–45.

- Dawe, K., & Ryan, L. (2003). The faulty three-legged-stool of sustainable development. *Conservative Biology*, 17(5), 1458–1460. doi:10.1046/j.1523-1739.2003.02471.x
- Daw, T., Adger, W. N., Brown, K., & Badjeck, M. C. (2009). Climate change and capture fisheries: potential impacts, adaptation and mitigation. In K. Cochrane, C. De Young, D. Soto, & T. Bahri (Eds.), *Climate change implications for fisheries and aquaculture: overview of current scientific knowledge*. FAO Fisheries and Aquaculture Technical Paper no. 530 (pp. 107–150). Food and Agriculture Organization of the United Nations, FAO.
- Day, G. S., & Schoemaker, P. J. (2016). Adapting to fast-changing markets and technologies. *California Management Review*, 58(4), 59–77. doi:10.1525/cmr.2016.58.4.59
- de Block, D., Feindt, P. H., & van Slobbe, E. (2019). Shaping conditions for entrepreneurship in climate change adaptation. *Ecology and Society*, 24(1), art19. doi:10.5751/ES-10310-240119
- De Coning, C. (2018). *Sustaining Peace: Can a new approach change the UN?* Academic Press.
- De Klerk, M., & De Villiers, C. (2012). The value relevance of corporate responsibility reporting: South African evidence. *Meditari Accountancy Research*, 20(1), 21–38. doi:10.1108/10222521211234200
- De Rensis, F., & Scaramuzzi, R. J. (2003). Heat stress and seasonal effects on reproduction in the dairy cow: A review. *Theriogenology*, 60(6), 1139–1151. doi:10.1016/S0093-691X(03)00126-2 PMID:12935853
- De Villiers, C., Hsiao, P.-C. K., & Maroun, W. (2017). Developing a conceptual model of influences around integrated reporting, new insights and directions for future research. *Meditari Accountancy Research*, 25(4), 450–460. doi:10.1108/MEDAR-07-2017-0183
- Debay, T. (2010). *The impact of climate change in Africa*. ISS Paper 220.
- Debnath, S., Bose, S., & Dhalla, R. (2011). Environmental Management Accounting: An Overview of its Methodological Development. *International Journal of Business Insights & Transformation*, 5(1).
- Decision Making Under Deep Uncertainty (DMDU) Society. (2020). *About Us*. <https://www.deepuncertainty.org/about-us/>
- Deen-Swarray, M., Moyo, M., & Stork, C. (2013). ICT access and usage among informal businesses in Africa. *Info*, 15(5), 52–68. doi:10.1108/info-05-2013-0025
- Deepa, P., & Karpagam, C. (2018). A study on customer's awareness on green banking in selected public and private sector banks with reference to Tirupur. *International Journal of Advanced Research and Development*, 3(1), 58–63.
- Deichmann, U., Goyal, A., & Mishra, D. (2016). *Will digital technologies transform agriculture in developing countries?* The World Bank. doi:10.1596/1813-9450-7669
- Deka, G. (2015). Green Banking Practices: A Study on environmental strategies of banks with special reference to State bank of India. *Indian Journal of Commerce and Management Studies*, 6(3), 11–19.
- Delery, J. E., & Roumpi, D. (2017). Strategic human resource management, human capital and competitive advantage: Is the field going in circles? *Human Resource Management Journal*, 27(1), 1–21. doi:10.1111/1748-8583.12137
- Dellmuth, L. M., Gustafsson, M. T., Bremberg, N., & Mobjörk, M. (2018). Intergovernmental organizations and climate security: Advancing the research agenda. *Wiley Interdisciplinary Reviews: Climate Change*, 9(1), e496. doi:10.1002/wcc.496
- Delmas, M., & Toffel, M. W. (2004). Stakeholders and environmental management practices: An institutional framework. *Business Strategy and the Environment*, 13(4), 209–222. doi:10.1002/bse.409

Compilation of References

- Deloitte Center for Financial Services (2019). *Insurance Regulator State of Climate Risks Survey*. Latest news from @ DeloitteFinSvcs, Sharing Insights.
- Deloitte. (2019). *Feeling the heat? Companies are under pressure to act on climate change and need to do more*. <https://www2.deloitte.com/us/en/insights/topics/strategy/impact-and-opportunities-of-climate-change-on-business.html>
- Deloitte. (2019). *How insurance companies can prepare for risk from climate change. Industry regulators sharpen their focus*. Retrieved from <https://www2.deloitte.com/us/en/pages/financial-services/articles/insurance-companies-climate-change-risk.html>
- Demaria, S., & Rigot, S. (2021). Corporate environmental reporting: Are French firms compliant with the Task Force on Climate Financial Disclosures' recommendations? *Business Strategy and the Environment*, 30(1), 721–738. doi:10.1002/bse.2651
- Demirel, P., Li, Q. C., Rentocchini, F., & Tamvada, J. P. (2019). Born to be green: New insights into the economics and management of green entrepreneurship. *Small Business Economics*, 52(4), 759–771. doi:10.1007/1187-017-9933-z
- Department for International Department. (2008). Impact of climate change on Nigeria's economy. DFID.
- Deschênes, O., & Greenstone, M. (2011). Climate change, mortality, and adaptation: Evidence from annual fluctuations in weather in the US. *American Economic Journal. Applied Economics*, 3(4), 152–185. doi:10.1257/app.3.4.152
- Development in Practice. (2019, March). Nigeria's new SEC guidelines to boost sustainability reporting. *Development in Practice*. <http://dip.ng/journal/2019/3/17/nigerias-new-sec-guidelines-to-boost-sustainability-reporting>
- Dewhurst, M., & Guthridge, M. (2009). *Motivating people: Getting beyond money*. Retrieved from: <https://www.mckinsey.com/business-functions/organization/our-insights/motivating-people-getting-beyond-money>
- DFID. (2004). *Adaptation to climate change: the right information can help the poor to cope*. Global and Local Environment Team, Policy Division.
- Dhahri, S., & Omri, A. (2018). Entrepreneurship contribution to the three pillars of sustainable development: What does the evidence really say? *World Development*, 106, 64–77. doi:10.1016/j.worlddev.2018.01.008
- Dhamija, A., & Sahni, D. (2018). Green banking: Perception and willingness of customer to adapt green banking. *International Journal of Financial Management*, 7(2), 1–8.
- Dhanai, R., Negi, R. S., Singh, S., & Parmar, M. K. (2014). The effects of climate change on natural resources and socio-economic condition of Himalayan communities of Uttarakhand, India. *International Journal of Modern Communication Technologies & Research*, 2(11), 22. <https://media.neliti.com/media/publications/265749-the-effects-of-climate-change-on-natural-700dbe88.pdf>
- Dietz, S., Bowen, A., Dixon, C., & Gradwell, P. (2016). Climate value at risk' of global financial assets. *Nature Climate Change*, 6(7), 676–679. doi:10.1038/nclimate2972
- Dikau, S., & Volz, U. (2018). *Central Banking, Climate Change and Green Finance* (No. 867). <https://www.adb.org/publications/central-banking-climate-change-and-green->
- Dimelu, M. U. (2014). Challenges In building climate change mitigation and adaptation capacity of extension professionals in Nigeria. *PAT*, 10(1), 110-122. <https://pdfs.semanticscholar.org/82c2/4dfe13159cd47be90c418d2c67b087f69991.pdf>
- Dionne, G. (2013). Risk management: History, definition, and critique. *Risk Management & Insurance Review*, 16(2), 147–166. doi:10.1111/rmir.12016

Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC. OJ L 275, 25.10.2003, 32-46.

Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community. OJ L 140, 5.6.2009, 63-87.

Dissanayake, D., Herath, N., & Thanthree, P. (2014). *Managing Waste and Water with the Help of Environmental Management Accounting (EMA): A Sri Lankan Hotel Sector Case*. Academic Press.

Dixit, N., & Saroj, K. (1970). Acceptance of e-banking among adult customers: An empirical investigation in India. *Journal of Internet Banking and Commerce*, 15(2), 1-17.

Dixon, G., Bullock, O., & Adams, D. (2019). Unintended effects of emphasizing the role of climate change in recent natural disasters. *Environmental Communication*, 13(2), 135-143. doi:10.1080/17524032.2018.1546202

Dlugolecki, A., & Lafeld, S. (2005). *A Publication of Allianz AG Group and WWF International*. www.awsassets.panda.org

Dlugolecki, A., & Loster, T. (2003). Climate Change and the Financial Services Sector: An Appreciation of the UNEPFI Study. *The Geneva Papers on Risk and Insurance. Issues and Practice*, 28(3), 382-393. https://doi.org/10.1111/1468-0440.00232

Dobrinevski, A., & Jachnik, R. (2020). *Exploring options to measure the climate consistency of real economy investments: The manufacturing industries in Norway*. Retrieved from https://www.oecd-ilibrary.org/docserver/1012bd81-en.pdf?expires=1614255683&id=id&accname=guest&checksum=4E68612131B78D3533AE156F8B52F5AD

Doğan, M. (2010). *Sustainable destination of focused on ecomuseum and an implementation above Gökçeada* (Unpublished Master's Thesis). Çanakkale Onsekiz Mart University, Çanakkale.

Doğan, M. (2010). *Sustainable Destination of Focused On Ecomuseum And An Implementation Above Gokceada* (Unpublished Master's Thesis). Çanakkale University, Çanakkale.

Doh, S., & Kim, B. (2014). Government support for SME innovations in the regional industries: The case of government financial support program in South Korea. *Research Policy*, 43(9), 1557-1569. doi:10.1016/j.respol.2014.05.001

Domingues, A. R., Lozano, R., Ceulemans, K., & Ramos, T. B. (2017). Sustainability reporting in public sector organisations: Exploring the relation between the reporting process and organisational change management for sustainability. *Journal of Environmental Management*, 192, 292-301. doi:10.1016/j.jenvman.2017.01.074 PMID:28183029

Donnenfeld, Z., Hedden, S., & Crookes, C. (2018). *A delicate balance: Water scarcity in South Africa*. Academic Press.

Dowla, A. (2009). *Climate change and microfinance*. Grameen Foundation.

Doyle, T., & Chaturvedi, S. (2010). Climate territories: A global soul for the global south? *Geopolitics*, 15(3), 516-535. doi:10.1080/14650040903501054

DPS. (2019a). *Republik Indonesia melanjutkan komitmen dalam pembiayaan berkelanjutan melalui penerbitan green sukuk global*. Directorate of Islamic Financing (DPS) Directorate General of Budget Financing and Risk Management (DJPPR) Ministry of Finance (MoF) Republic of Indonesia.

DPS. (2019b). *Sukuk tabungan ST006, investasi hijau menjaga bumi*. Marketing Material of Directorate of Islamic Financing (DPS) Directorate General of Budget Financing and Risk Management (DJPPR) Ministry of Finance (MoF) Republic of Indonesia.

Compilation of References

- DPS. (2019c). *Press release: Retail green sukuk series ST006 successful to embrace 56% new millennial investors*. Directorate of Islamic Financing (DPS) Directorate General of Budget Financing and Risk Management (DJPPR) Ministry of Finance (MoF) Republic of Indonesia.
- DPS. (2020a). *Press release: Indonesian global sukuk issuance is flooded with order amounting to USD 16.66 billion for USD 2.5 billion issuance*. Directorate of Islamic Financing (DPS) Directorate General of Budget Financing and Risk Management (DJPPR) Ministry of Finance (MoF) Republic of Indonesia.
- DPS. (2020b). *Press release: In the middle of pandemic, green sukuk retail series ST007 successful to record the history of the biggest sales during the issuance of sukuk tabungan*. Directorate of Islamic Financing (DPS) Directorate General of Budget Financing and Risk Management (DJPPR) Ministry of Finance (MoF) Republic of Indonesia.
- Drzik, J. P. (2020). *The heat is on businesses to respond to climate change*. Retrieved from <https://www.weforum.org/agenda/2020/01/climate-change-business-response-risks/>
- Duan, W. (2019). *An analysis of the development of “green” hotels in a small to medium-sized city-Kunming*. Auckland University of Technology.
- Duarte, C. M., Losada, I. J., Hendriks, I. E., Mazarrasa, I., & Marbà, N. (2013). The role of coastal plant communities for climate change mitigation and adaptation. *Nature Climate Change*, 3(11), 961–968. doi:10.1038/nclimate1970
- Dube, K., & Nhamo, G. (2020). Vulnerability of nature-based tourism to climate variability and change: Case of Kariba resort town, Zimbabwe. *Journal of Outdoor Recreation and Tourism*, 29, 100281. doi:10.1016/j.jort.2020.100281
- Dunuwila, P., Rodrigo, V., & Goto, N. (2020). Improving financial and environmental sustainability in concentrated latex manufacture. *Journal of Cleaner Production*, 255, 120202.
- Duru, B. (2014). *Yeni ÇED Yönetmeliğinin Anlamı*. <http://kentcevre.politics.ankara.edu.tr/Duru%20CED%20Yonetmeliği%20.pdf>
- Duru, P. N. (2014). Green economy and renewable energy sources in Nigeria: The way forward. *International Journal of Research in Earth & Environmental Sciences*, 2(4), 1–4.
- Dutta, A., & Banerjee, S. (2018). Does microfinance impede sustainable entrepreneurial initiatives among women borrowers? Evidence from rural Bangladesh. *Journal of Rural Studies*, 60, 70–81. doi:10.1016/j.jrurstud.2018.03.007
- Dutta, D. (2012). Greening people: A strategic dimension. *ZENITH International Journal of Business Economics & Management Research*, 2(2), 143–148.
- Dvorakova, Z.L, Cudlinova, E., Partlova, P., & Petr, D. (2016). Importance of Green Marketing and its potential. *Journal of Bioeconomy and Sustainable Development*, 5(2), 61-64.
- Dwyer, R. (2009). “Keen to be green” organizations: A focused rules approach to accountability. *Management Decision*, 47(7), 1200–1216. doi:10.1108/00251740910978377
- Eceiza, J., Harreis, H., Hartl, D., & Viscardi, S. (2020). *Banking imperatives for managing climate risk*. McKinsey & Company.
- Echekoba, F. N., & Okonkwo, I. V. (2015). Impact of loan syndication in the growth of Nigeria economy. *Developing Country Studies*, 5(14), 58–64.
- Ecological impacts of Climate Change. (2008). *Committee on Ecological Impacts of Climate Change*. United States Geological Survey.
- Economist Intelligence Unit. (2015). *The cost of inaction: Recognise the value at risk from climate change*. Report 2015.

- Economist Intelligence Unit. (2015). *The cost of inaction: reorganising the value at risk from climate change*. https://eiuperspectives.economist.com/sites/default/files/The%20cost%20of%20inaction_0.pdf
- Edoun, E., Mbohwa, C., & Bhila, M. T. Y. (2019). *The impact of waste management in the hospitality industry Johannesburg north*. Academic Press.
- Edwards, D. (1998). *The link between company environmental and financial performance*. Earthscan.
- EEX. (2021). *EU ETS Auctions*. Retrieved from <https://www.eex.com/en/markets/environmental-markets/eu-ets-auctions>
- Ehrenfeld, J. (2008). *Sustainability by Design*. <http://baudson.cute-ice.de/serendipity/index.php?/archives/27-Sustainability-by-Design-John-R.-Ehrenfeld,-2008.html>
- Ehrhart, M. G., & Kuenzi, M. (2017). *The impact of organizational climate and culture on employee turnover*. doi:10.1002/9781118972472.ch231
- EIONET. (2014-2020). *Overview Art. 17 - Use of auctioning revenue and project credits*. Retrieved from http://cdr.eionet.europa.eu/Converters/pl/eu/mmr/art17_auctioning/
- Eisenhart, K. M., & Sull, D. N. (2001). Strategy as simple rules. *Harvard Business Review*, 79(1), 107–115. PMID:11189455
- Eisenmenger, N., Pichler, M., Krenmayr, N., Noll, D., Plank, B., Schalmann, E., & Gingrich, S. (2020). The Sustainable Development Goals prioritize economic growth over sustainable resource use: A critical reflection on the SDGs from a socio-ecological perspective. *Sustainability Science*, 15(4), 1101–1110. doi:10.1007/11625-020-00813-x
- Elfeky, M. I. (2017). The extent of voluntary disclosure and its determinants in emerging markets: Evidence from Egypt. *The Journal of Finance and Data Science*, 3(1), 45–59. doi:10.1016/j.jfds.2017.09.005
- Elkington, J. (2004). Enter the triple bottom line. In A. Henriques & J. Richardson (Eds.), *The Triple Bottom Line: Does it All Add Up? Assessing the Sustainability of Business and CSR* (Vol. 1). Earthscan. doi:10.4324/9781849773348
- Elkington, J. (2018). 25 years ago I coined the phrase “triple bottom line.” Here’s why it’s time to rethink it. *Harvard Business Review*. <https://hbr.org/2018/06/25-years-ago-i-coined-the-phrase-triple-bottom-line-heres-why-im-giving-up-on-it>
- Elum, Z. A., & Momodu, A. S. (2017). Climate change mitigation and renewable energy for sustainable development in Nigeria: A discourse approach. *Renewable and Sustainable Energy Reviews, Elsevier*, 76(C), 72–80. doi:10.1016/j.rser.2017.03.040
- Embry, E., Jones, J., & York, J. G. (2019). Climate change and entrepreneurship. In *Handbook of Inclusive Innovation*. Edward Elgar Publishing. doi:10.4337/9781786436016.00032
- Endl, A. (n.d.). *Sustainable investment: options for a contribution to a more sustainable financial sector*. https://www.sdnetwork.eu/pdf/case%20studies/ESDN%20Case%20Study_No.%2011_sustainable%20investment_FINAL.pdf
- Endrikat, J., Guenther, E., & Hoppe, H. (2014). Making Sense of Conflicting Empirical Findings: A Meta-analytic Review of the Relationship between Corporate Environmental and Financial Performance. *European Management Journal*, 32(5), 735–751. doi:10.1016/j.emj.2013.12.004
- Eneizan, B. M., & Wahab, K. A. (2016). Effects of Green Marketing Strategy on the Financial and Non-Financial Performance of Firms: A Conceptual Paper. *Arabian J Bus Manag Review*, 6, 254.
- Enete, A. A., & Amusa, A. T. (2010). Challenges of Agriculture Adaptation to climate change in Nigeria: a synthesis from the literature. *The Journal of Field Actions Science Reports*, 2, 1-22.

Compilation of References

- Enterprise Risk Management Committee (ERM). (2003). Overview of Enterprise Risk Management. Casualty Actuarial Society.
- Environmental Protection Agency (EPA). (2019). *Managing Air Quality - Control Strategies to Achieve Air Pollution Reduction*. Available at: <https://www.epa.gov/air-quality-management-process/managing-air-quality-control-strategies-achieve-air-pollution>
- EP Association Members & Reporting. (2020). The Equator Principles Association. <https://equator-principles.com/members-reporting/>
- Epetimehin, F. M. (2011). Achieving competitive advantage in insurance industry: The impact of marketing innovation and creativity. *Journal of Emerging Trends in Economics and Management Science*, 2(1), 18–21.
- Erasmus, B., Loedolff, P., Mda, T., & Nel, P. (2015). *Managing training and development* (7th ed.). Cape Town: Oxford University Press Southern Africa (Pty) Ltd.
- Eregha, P. B., Babatolu, J. S., & Akinnubi, R. T. (2014). Climate change and crop production in Nigeria: An Error Correction Modeling Approach. *International Journal of Energy Economics and Policy*, 4(2), 297–311.
- Erkara, A. (2019). *Determination of the principles of sustainable tourism in urban* (Unpublished Master's Thesis). Gazi University, Ankara.
- Ernst & Young. (2008). *Synteza analiz dotyczących skutków społeczno-ekonomicznych pakietu energetyczno-klimatycznego UE*. Author.
- Esch, M., Schulze, M., & Wald, A. (2019). The dynamics of financial information and non-financial environmental, social and governance information in the strategic decision-making process. *Journal of Strategy and Management*, 12(3), 314–329. doi:10.1108/JSMA-05-2018-0043
- Esgicioğlu, N. (2007). *Problems faced and solution recommendations in the environmental impact assessment applications in Turkey* (Unpublished Master's Thesis). Çukurova University, Adana.
- EU SME center. (2019). SMEs in China: Policy. *Environment Reporter*, 22(July). http://www.stats.gov.cn/tjsj/tjbz/201801/t20180103_1569357.html
- Europa, B. (2019). *The chemical industry's contributions to climate change*. Retrieved from: <https://bellona.org/news/eu/2019-04-the-industrys-chemistry-with-climate-change>
- European Central Bank. (2020). *Positively green: measuring climate change risks to financial stability*. <http://financial-stability.org/measuring-climate-change-risks-to-financial-stability/>
- Eurostat. (2020). *Shedding light on energy in the EU. A guided tour of energy statistics*. Retrieved from <https://ec.europa.eu/eurostat/cache/infographs/energy/>
- Evangelinos, K. I., Skouloudis, A., Nikolaou, I. E., & Filho, W. L. (2009). *An Analysis of Corporate Social Responsibility (CSR) and Sustainability Reporting Assessment in the Greek*. In *Professionals Perspectives of Corporate Social Responsibility*. Springer-Verlag Berlin Heidelberg.
- Evangelinos, K., Nikolaou, I., & Leal Filho, W. (2015). The effects of climate change policy on the business community: A corporate environmental accounting perspective. *Corporate Social Responsibility and Environmental Management*, 22(5), 257–270. doi:10.1002/csr.1342

- Evans, C. D., Monteith, D. T., & Cooper, D. M. (2005). Long-term increases in surface water dissolved organic carbon: Observations, possible causes and environmental impacts. *Environmental Pollution*, 137(1), 55–71. doi:10.1016/j.envpol.2004.12.031 PMID:15944040
- Evans, G. W. (2004). The environment of childhood poverty. *The American Psychologist*, 59(2), 77–92. doi:10.1037/0003-066X.59.2.77 PMID:14992634
- Fabris, N. (2020). Financial stability and climate change. *Journal of Central Banking Theory and Practice*, 3(3), 27–43. doi:10.2478/jcbtp-2020-0034
- Fagariba, C. J., Song, S., & Baoro, S. K. G. S. (2018). Climate change in Upper East Region of Ghana; challenges existing in farming practices and new mitigation policies. *Open Agriculture*, 3(1), 524–536. doi:10.1515/opag-2018-0057
- Fagerholm, F., Hellas, A., Luukkainen, M., Kyllönen, K., Yaman, S., & Mäenpää, H. (2018). Designing and implementing an environment for software start-up education: Patterns and anti-patterns. *Journal of Systems and Software*, 146, 1–13. doi:10.1016/j.jss.2018.08.060
- Fahimnia, B., Sarkis, J., & Davarzani, H. (2015). Green supply chain management: A review and bibliometric analysis. *International Journal of Production Economics*, 162, 101–114. doi:10.1016/j.ijpe.2015.01.003
- Faircent. (2021). *About Us*. Available at: <https://www.faircent.com/about-us>
- Fakoya, M. B., & van der Poll, H. M. (2013). Integrating ERP and MFCA systems for improved waste-reduction decisions in a brewery in South Africa. *Journal of Cleaner Production*, 40, 136–140.
- Faniran, G. B., Afon, A. O., & Dada, O. T. (2017). Solid waste management during monthly environmental sanitation exercise in Ibadan municipality Nigeria. *Management of Environmental Quality*, 28(6), 868–878. doi:10.1108/MEQ-03-2016-0030
- Fankhauser, S., Sahni, A., Savvas, A., & Ward, J. (2016). Where are the gaps in climate finance? *Climate and Development*, 8(3), 203–206. doi:10.1080/17565529.2015.1064811
- FAO. (2007). *Climate change and food security*. FAO.
- FAO. (2008). Strategic framework for forests and climate change. A proposal by the Collaborative Partnership on Forests for a coordinated forest-sector response to climate change. FAO.
- FAO. (2017). *B3 Climate-smart forestry*. Retrieved 18th February 2021 from <http://www.fao.org/climate-smart-agriculture-sourcebook/production-resources/module-b3-forestry/b3-overview/en/?type=111>
- FAO. (2018). *Climate Change Adaptation and Mitigation*. Retrieved 18th February 2021 from <http://www.fao.org/sustainable-forest-management/toolbox/modules/climate-change-adaptation-and-mitigation/tools/en/?type=111>
- FAO. (2019). The future of livestock in Nigeria. Opportunities and challenges in the face of uncertainty. FAO.
- FAO. (2020). *Livestock Production and Climate Change*. Climate Smart Agriculture Sourcebook. Accessed from www.fao.org
- FAOSTAT. (2019). Available at: <http://www.fao.org/faostat/en/#data/TP>
- Fayard, G. M. (2009). Fatal work injuries involving natural disasters, 1992–2006. *Disaster Medicine and Public Health Preparedness*, 3(4), 201–209. doi:10.1097/DMP.0b013e3181b65895 PMID:20081416
- Fayyazi, M., Shahbazmoradi, S., Afshar, Z., & Shahbazmoradi, M. (2015). Investigating the barriers of the green human resource management implementation in oil industry. *Management Science Letters*, 5(1), 101–108.

Compilation of References

- Federal Ministry of Environment. (2014). *Nigeria's second National Communication under the United Nations Framework Convention on Climate Change*. Abuja: Federal Ministry of Environment.
- Federal Ministry of Environment. (2014). *United Nations Climate Change Nigeria. National Communication (NC)*. NC 2. 2014. <https://unfccc.int/sites/default/files/resource/nganc2.pdf>
- Feldman, R.A. & Wagner, N., 2002. The financial sector, macroeconomic policy, and performance. *EIB Papers*, 7(2), 13-30.
- Felix, K. (2015). Factors for customer satisfaction and customer dissatisfaction in commercial banks. *Mediterranean Journal of Social Sciences*, 6(4), 584–589. doi:10.5901/mjss.2015.v6n4s2p584
- Feng, Y., Chen, H.H., & Tang, J. (2018). The Impacts of Social Responsibility and Ownership Structure on Sustainable Financial Development of China's Energy Industry. *Sustainability*, 10(2), 301. doi:10.3390/u10020301
- Feridun, M. (2020). *What do the Evolving Prudential Regulations on Climate Change Risks Mean for Banks?* Oxford Business Law Blog. Available online:<https://www.law.ox.ac.uk/business-law-blog/blog/2020/01/whatdo-evolving-prudential-regulations-climate-change-risks-mean>
- Fernández, E., Junquera, B., & Ordiz, M. (2003). Organizational culture and human resources in the environmental issue: A review of the literature. *International Journal of Human Resource Management*, 14(4), 634–656. doi:10.1080/0958519032000057628
- Feyen, E. H., Utz, R. J., Zuccardi Huertas, I. E., Bogdan, O., & Moon, J. (2020) Macro-Financial Aspects of Climate Change. World Bank Group.
- Figueres, C., Schellnhuber, H. J., Whiteman, G., Rockström, J., Hobley, A., & Rahmstorf, S. (2017). Three years to safeguard our climate. *NATNews*, 546(7660), 593. PMID:28661507
- Financial Stability Board. (2017). *Implementing the recommendations of the Task force on Climate-related Financial Disclosures*. Retrieved on 22/01/2021 www.fsb.org/wp-content/uploads/r_121029.pdf
- Financial Stability Board. (2020). *The implications of climate change for financial stability*.
- Financial Stability Oversight Council. (2012). Authority to require supervision and regulation of certain nonbank financial companies. *Federal Register*, 77(70), 21637–21662.
- Fink, L. (2020, January 14). *A Fundamental Reshaping of Finance*. BlackRock. Retrieved from <https://www.blackrock.com/corporate/investor-relations/larry-fink-ceo-letter>
- Fiore, A. M., Naik, V., & Leibensperger, E. M. (2015). Air quality and climate connections. *Journal of the Air & Waste Management Association*, 65(6), 645–685. doi:10.1080/10962247.2015.1040526 PMID:25976481
- Firpo, J. (2009). Banking the unbanked: Issues in designing technology to deliver financial services to the poor. In *New Partnerships for Innovation in Microfinance* (pp. 186–197). Springer. doi:10.1007/978-3-540-76641-4_11
- Florida, R., & Davison, D. (2001). Gaining from Green Management: Environmental Management Systems inside and outside the Factory. *California Management Review*, 43(3), 64–84. doi:10.2307/41166089
- FMARD. (2017). *Animal population data*. Federal Ministry of Agriculture and Rural Development.
- Folk, E. (2018). *How Climate Change Will Affect Businesses*. Available at: <https://www.renewableenergymagazine.com/emily-folk/how-climate-change-will-affect-businesses-20181109>
- Folk, E. (2018). *How climate change will affect businesses*. Retrieved from <https://www.renewableenergymagazine.com/emily-folk/how-climate-change-will-affect-businesses-20181109>

- Folnovic, T. (2020). *Climate Change impacts on Agriculture*. Accessed from <https://www.agrivi.com>
- Food and Agriculture Organization (FAO). (2004). *FAO recommendations on the prevention, control and eradication of highly pathogenic avian influenza (HPAI) in Asia*. FAO Position Paper. FAO.
- Food and Agriculture Organization (FAO). (2009). *The state of world fisheries and Aquaculture-2008 (SOFIA)*. FAO Fisheries and Aquaculture Department.
- Food and Agriculture Organization (FAO). (2016). *State of World Fisheries and Aquaculture-Contributing to food security and nutrition for all*. Fisheries and Aquaculture Department, Food and Agriculture Organization of the United Nations.
- Food and Agriculture Organization (FAO). (2020). *The State of World Fisheries and Aquaculture 2020. Sustainability in action*. doi:10.4060/ca9229en
- Forbes. (2014). *11 Of The Best Strategic Brand Partnerships In 2014*. Available at: <https://www.forbes.com/sites/michellgreenwald/2014/12/11/11-of-the-best-smartest-most-interesting-strategic-brand-partnerships-of-2014>
- Foundation myclimate. (2020). *What are the effects of climate change?* Myclimate: Shape Our Future. <https://www.myclimate.org/information/faq/faq-detail/what-are-the-effects-of-climate-change/>
- Francart, N., Larsson, M., Malmqvist, T., Erlandsson, M., & Florell, J. (2019). Requirements set by Swedish municipalities to promote construction with low climate change impact. *Journal of Cleaner Production*, 208, 117–131. doi:10.1016/j.jclepro.2018.10.053
- Frasz, G. (2005). Benevolence as an environmental virtue. In R. Sandler & P. Cafaro (Eds.), *Environmental virtue ethics* (pp. 121–139). Rowman & Littlefield.
- Frayne, B., Moser, C., & Ziervogel, G. (2012). *Climate change, assets and food security in Southern African cities*. Retrieved from <https://www.routledge.com/Climate-Change-Assets-and-Food-Security-in-Southern-African-Cities/Frayne-Moser-Ziervogel/p/book/9780815357445>
- Freeman, R., Pierce, J., & Dodd, R. (2000). *Environmentalism and the New Logic of Business*. Oxford University Press.
- French Prudential Supervision and Resolution Authority. (2020). *Governance and management of climate related risks by French banking institutions: some good practices*. Author.
- Friend, G. (2009). *The truth about green business*. FT Press.
- Fuentes-Moraleda, L., Lafuente-Ibáñez, C., Muñoz-Mazón, A., & Villacé-Molinero, T. (2019). Willingness to pay more to stay at a boutique hotel with an environmental management system. A preliminary study in Spain. *Sustainability*, 11(18), 5134.
- Futurelearn. (2021). *Impact of agriculture on climate change*. Accessed from <https://www.futurelearn.com>
- Futurelearn. (2021). *Impact of climate change on agriculture*. Accessed from <https://www.futurelearn.com>
- Futures Europe, I. C. E. (2021). *EUA UK Auction*. Retrieved from <https://www.theice.com/products/18997864/EUA-UK-Auction-Daily-Futures>
- Fu, X., Song, J., Sun, B., & Peng, Z. R. (2016). “Living on the edge”: Estimating the economic cost of sea level rise on coastal real estate in the Tampa Bay region, Florida. *Ocean and Coastal Management*, 133, 11–17. doi:10.1016/j.ocecoaman.2016.09.009
- Gajanan, R. (2015). A study on sustainable marketing practices for gaining competitive advantage. *Elk Asia Pacific Journal of Marketing and Retail Management*, 6(4), 1–9.

Compilation of References

- Galbreath, J., Charles, D., & Oczkowski, E. (2016). The drivers of climate change innovations: Evidence from the Australian wine industry. *Journal of Business Ethics*, 135(2), 217–231. doi:10.1007/10551-014-2461-8
- Gale, R. (2006). Environmental management accounting as a reflexive modernization strategy in cleaner production. *Journal of Cleaner Production*, 14(14), 1228–1236.
- Gallego-Schmid, A., Chen, H. M., Sharmina, M., & Mendoza, J. M. F. (2020). Links between circular economy and climate change mitigation in the built environment. *Journal of Cleaner Production*, 260, 121115. doi:10.1016/j.jclepro.2020.121115
- Gambarelli, G. (2020). *Climate change, new risks and opportunities for businesses. Businesses should evaluate the risks and opportunities of climate change and its mitigation to ensure their long-term resilience and success*. Retrieved from <https://www.lifegate.com/climate-change-risks-opportunities-businesses>
- Ganesan & Bhuvanewari, A. (2016). Customer perception towards green banking. *IOSR Journal of Economics and Finance*, 7(5), 5-17.
- Garavan, T. N., & McGuire, D. (2010). Human resource development and society: Human resource development's role in embedding corporate social responsibility, sustainability, and ethics in organizations. *Advances in Developing Human Resources*, 12(5), 487–507. doi:10.1177/1523422310394757
- Gardner, A. L. (2020). Climate Change and the Environment. In *Stars with Stripes* (pp. 379-421). Palgrave Macmillan. doi:10.1007/978-3-030-29966-8_11
- Garzon-Villalba, X. P., Mbah, A., Wu, Y., Hiles, M., Moore, H., Schwartz, S. W., & Bernard, T. E. (2016). Exertional heat illness and acute injury related to ambient wet bulb globe temperature. *American Journal of Industrial Medicine*, 59(12), 1169–1176. doi:10.1002/ajim.22650 PMID:27779310
- Gast, J., Gundolf, K., & Cesinger, B. (2017). Doing business in a green way: A systematic review of the ecological sustainability entrepreneurship literature and future research directions. *Journal of Cleaner Production*, 147, 44–56. doi:10.1016/j.jclepro.2017.01.065
- Gaugler, T., Stoeckl, S., & Rathgeber, A. W. (2020). Global climate impacts of agriculture: A meta-regression analysis of food production. *Journal of Cleaner Production*, 276, 122575. doi:10.1016/j.jclepro.2020.122575
- Gbandi, E. C., & Amisah, G. (2014). Financing options for small and medium enterprises (SMEs) in Nigeria. *European Scientific Journal*, 10(1), 326–340.
- Geels, F. W. (2013). The impact of the financial–economic crisis on sustainability transitions: Financial investment, governance and public discourse. *Environmental Innovation and Societal Transitions*, 6, 67–95. doi:10.1016/j.eist.2012.11.004
- Geiger, P., Cajias, M., & Bienert, S. (2013). The asset allocation of sustainable real estate: A chance for a green contribution? *Journal of Corporate Real Estate*, 15(1), 73–91. doi:10.1108/JCRE-11-2012-0029
- Gelzinis, G., & Steele, G. (2019). *Climate change threatens the stability of the financial system*. Centre for American Progress.
- George, A., & Kumar, G. (2014). Impact of service quality dimensions in internet banking on customer satisfaction. *Journal of Mathematics and Computer Science*, 41(1), 73–85.
- George, F. O. A. (2010). Indigenous and emerging technologies for climate change adaptation in aquaculture and fisheries. *Journal of Sustainable Development*, 7(2), 34–42.
- Georgieva, K. (2009). The role of the sun in climate change. *IOP Conference Series. Earth and Environmental Science*, 6(9), 092016. doi:10.1088/1755-1307/6/9/092016

- Gerber, P. J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Falcucci, A., & Tempio, G. (2013). *Tackling Climate Change Through Livestock: A Global Assessment of Emissions and Mitigation Opportunities*. FAO.
- Gergel, D. R., Nijssen, B., Abatzoglou, J. T., Lettenmaier, D. P., & Stumbaugh, M. R. (2017). Effects of Climate Change on Snowpack and Fire Potential in the Western USA. [Google Scholar]. *Climatic Change*, *141*(2), 287–299. doi:10.1007/10584-017-1899-y
- Ghaffar, S. H., Burman, M., & Braimah, N. (2020). Pathways to circular construction: An integrated management of construction and demolition waste for resource recovery. *Journal of Cleaner Production*, *244*, 118710. doi:10.1016/j.jclepro.2019.118710
- Ghalwash, S., Tolba, A., & Ismail, A. (2017). What motivates social entrepreneurs to start social ventures? *Social Enterprise Journal*.
- Ghazouani, A., Xia, W., Jebli, M. B., & Shahzad, U. (2020). Exploring the role of carbon taxation policies on CO₂ emissions: Contextual evidence from tax implementation and non-implementation European countries. *Sustainability*, *12*(20), 4. doi:10.3390/s12208680
- Gholami, H., Rezaei, G., Saman, M. Z. M., Sharif, S., & Zakuan, N. (2016). State-of-the-art Green HRM System: Sustainability in the sports center in Malaysia using a multi-methods approach and opportunities for future research. *Journal of Cleaner Production*, *124*, 142–163. doi:10.1016/j.jclepro.2016.02.105
- Giannarakis, G., Zafeiriou, E., Arabatzis, G., & Partalidou, X. (2018). Determinants of corporate climate change disclosure for European firms. *Corporate Social Responsibility and Environmental Management*, *25*(3), 281–294. doi:10.1002/csr.1461
- Gibassier, D., & Alcouffe, S. (2018). Environmental management accounting: The missing link to sustainability? *Social and Environmental Accountability Journal*, *38*(1).
- Giddens, A. (2011). *The politics of climate change: National responses to the challenge of Global warming*. Policy Network.
- Giglio, S., Maggiori, M., Stroebel, J., & Weber, A. (2015). *Climate change and long-run discount rates: Evidence from real estate (No. w21767)*. National Bureau of Economic Research. doi:10.3386/w21767
- Gilles, N. G., Foster, J., Dalton, M. M., Mote, P. W., Rupp, D. E., Stevenson, J., Serafin, K. A., Evans-Wilent, J., Ruggiero, P., & Abatzoglou, J. T. (2017). Responding to Climate Variability and Change in the Pacific Northwest United States: The Pacific Northwest Climate Impacts Research Consortium, September 2010–August 2017 Phase 1 Final Report. The Pacific Northwest Climate Impacts Research Consortium (CIRC).
- Girvetz, E., Rosenstock, T., & Nowak, A. (2019). Future Climate Projections in Africa: Where Are We Headed? In *The Climate-Smart Agriculture Papers*. Springer. doi:10.1007/978-3-319-92798-5_2
- Gizaw, M., Kebede, M., & Selvaraj, S. (2015) The impact of credit risk on the profitability on of commercial banks in Ethiopia. *African Journal of Caribbean Central Bank*.
- Global Forest Watch. (n.d.). *Tree Cover Loss*. www.globalforestwatch.org
- Godden, L., Rochford, F., Peel, J., Caripis, L., & Carter, R. (2013). Law, governance, and risk: Deconstructing the public-private divide in climate change adaptation. *The University of New South Wales Law Journal*, *36*(1), 224–255.
- Goel, R. (2020). Renewable Energy Startups and SME. doi:10.20944/preprints202008.0488.v1
- Gökdeniz, A. (2004). Local Agenda 21 and Eco Tourism within the framework of Sustainable Tourism Policies. *Journal of Standard*.

Compilation of References

- Göktuğ, T. H., Demircioğlu Yıldız, N., Demir, M., & Bulut, Y. (2013). Formation- Development and Modelling Process of Carrying Capacity Theory in the National Parks. *Atatürk Univ. J. of the Agricultural Faculty*, 44(2), 195–206.
- Goldstein, A., Turner, W. R., Gladstone, J., & Hole, D. G. (2019). The private sector's climate change risk and adaptation blind spots. *Nature Climate Change*, 9(1), 18–25. doi:10.1038/41558-018-0340-5
- Goleman, D. (2013). *The three kinds of focus every leader needs*. Available at <http://www.haygroup.com/>
- Golić, Z. (2014). Advantages of crowdfunding as an alternative source of financing of small and medium-sized enterprises. *Zbornik radova Ekonomskog fakulteta u Istočnom Sarajevu*, (8), 39-48.
- Golicic, S., Boerstler, C., & Ellram, L. (2010). 'Greening' Transportation in the Supply Chain. *Sloan Management Review*, 51(2), 47–55.
- Gopalakrishnan, M. S., & Muruganandam, D. A. (2013). Micro analysis on Dissect of Consumer's to Procure Green Products. *Life Science Journal*, 10(2), 1028–1032.
- Gordon, R. K. (1998). *Depreciation, amortization, and depletion*. Retrieved from <https://www.imf.org/external/pubs/nft/1998/tlaw/eng/ch17.pdf>
- Gorgen, M., Jacob, A., Nerlinger, M., Riordan, R., Rohleder, M. & Wilkens, M. (2017). *Carbon risk*. University of Augsburg, Working 672019.
- Gori, A., Brito, C. B., & Ruiz, J. (2018). Climate change and agriculture: Do environmental preservation and ecosystem services matter? *Ecological Economics*, 152, 27–39. doi:10.1016/j.ecolecon.2018.05.013
- Gössling, S., & Scott, D. (2018). The decarbonisation impasse: Global tourism leaders' views on climate change mitigation. *Journal of Sustainable Tourism*, 26(12), 2071–2086. <https://doi.org/10.1080/09669582.2018.1529770>
- Graci, S., & Kuehnel, J. (2011). *How to increase your bottom line by going green*. Green Hotels & Responsible Tourism Initiative.
- Gray, R. (2006). Social, environmental and sustainability reporting and organisational value creation? Whose value? Whose creation? *Accounting, Auditing & Accountability Journal*, 19(6), 793–819. doi:10.1108/09513570610709872
- Great Lakes Integrated Sciences Assessment. (2009). *Climate change impacts on natural resources*. Retrieved from <https://www.hrwc.org/wp-content/uploads/HRWC-Natural-Resources.pdf>
- Gregory, A. A., & Angelina, C. S. (2006). Organizational climate partially mediates the effect of culture on work attitudes and staff turnover in mental health services. *Administration and Policy in Mental Health*, 3(33), 299. doi:10.1007/10488-006-0039-1
- GRI. (2013). *G4 sector-specific disclosures for financial services*. Global Reporting Initiative. <https://www.globalreporting.org/search/?query=G4>
- GRI. (2020). *Consolidated Set of GRI Sustainability Reporting Standards 2020*. GRI. <https://www.globalreporting.org/how-to-use-the-gri-standards/resource-center/?g=3a367786-7fee-40e7-824a-53caadc909>
- Groysberg, B., Lee, J., Price, J., & Cheng, J. (2018). The leader's guide to corporate culture. *Harvard Business Review*, 96(1), 44–52.
- Gu, Wang, Hua, & Liu. (n.d.). Entrepreneurship and high-quality economic development: Based on the triple bottom line of sustainable development. *International Entrepreneurship and Management Journal*, 1–27.

- Guest, D. E. (2017). Human resource management and employee well-being: Towards a new analytic framework. *Human Resource Management Journal*, 27(1), 22–38. doi:10.1111/1748-8583.12139
- Gulluscio, C., Puntillo, P., Luciani, V., & Huisingh, D. (2020). Climate Change Accounting and Reporting: A Systematic Literature Review. *Sustainability*, 12(13), 54–55. doi:10.3390/12135455
- Gumelar, G. (2019, February 2). Sukuk global RI terbit, Timur Tengah dan AS paling berminat. *CNN Indonesia*. Retrieved from <https://www.cnnindonesia.com/ekonomi/20190222095325-532-371732/sukuk-global-ri-terbit-timur-tengah-dan-as-paling-berminat>
- Gunarathne, N., & Lee, K. (2013). *Adopting and Implementing Environmental Management Accounting (EMA) Practices in the Hotel Sector: A Sri Lankan Case*. Paper presented at the A paper presented at the EMAN Global Conference, Gold Coast, Queensland.
- Gunasekaran, A., Irani, Z., & Papadoulos, T. (2013). Modelling and Analysis of Sustainable Operations Management: Certain Investigations for Research and Applications. *Journal of Operational Research*, 1-18.
- Gunasekaran, A., & Irani, Z. (2014). Sustainable Operations Management: Design, Modelling and Analysis. *The Journal of the Operational Research Society*, 65(6), 801–805. doi:10.1057/jors.2014.26
- Gundlach, J. (2020). Climate risks are becoming legal liabilities for the energy sector. *Nature Energy*, 5(2), 94–97. doi:10.1038/41560-019-0540-x
- Gündüz, F. (1999). *Environmental impact assessment of tourism and environment sensitive sustainable tourism model* (Unpublished Doctoral Thesis). Istanbul Technical University, Istanbul.
- Gürbüz, K. (2020). Changes in the Legislation of Environmental Impact Assessment in Turkey. Library. *Archive and Museum Research Journal*, 3(1), 39–47.
- Gurenko, E., Lester, R., & Mahul, O. (2006). *Earthquake Insurance in Turkey: History of the Turkish Catastrophe Insurance Pool*. World Bank Publications. doi:10.1596/978-0-8213-6583-0
- Hackman, R. J., & Oldham, G. (1976). Motivation through the design of work: Test of a theory. *Organizational Behavior and Human Performance*, 16(2), 250–279. doi:10.1016/0030-5073(76)90016-7
- Haddock, J., Jeffrey, J., Miles, D., Muller-Camen, M., & Hartog, M. (2010). Green HRD: The potential contribution of HRD concepts and theories to environmental management. In *11th International Conference on Human Resource Development Research and Practice across Europe* (pp.1-18). Pécs, Hungary: University of Pécs.
- Hadj, T. B. (2020). Effects of corporate social responsibility towards stakeholders and environmental management on responsible innovation and competitiveness. *Journal of Cleaner Production*, 250, 119490. doi:10.1016/j.jclepro.2019.119490
- Haider, H. (2019). *Climate change in Nigeria: Impacts and responses*. K4D Helpdesk Report 675. Institute of Development Studies.
- Haidt, J. (2001). The emotional dog and its rational tail: A social intuitionist approach to moral judgment. *Psychological Review*, 108(4), 814–834. doi:10.1037/0033-295X.108.4.814 PMID:11699120
- Haijiao, Z., & Fangping, C. (2013). *Construction of Competitive Green Management Strategy: Based on Empirical Research about Green Management and Competitive Advantage*. Science & Technology Progress and Policy.
- Hakimi, A., Abedi, Z., & Dadashian, F. (2020). *Increasing Energy and Material Consumption Efficiency by Application of Material and Energy Flow Cost Accounting System (Case Study: Turbine Blade Production)*. Academic Press.

Compilation of References

- Hallegatte, S., & Brian Walsh, B. (2020). COVID, climate change and poverty: Avoiding the worst impacts. *World Bank Group*. <https://blogs.worldbank.org/climatechange/covid-climate-change-and-poverty-avoiding-worst-impacts>
- Hallegatte, S., Franck Lecocq, F., & De Perthuis, C. (2011). *Designing Climate Change Adaptation Policies: An Economic Framework*. Available at: <https://openknowledge.worldbank.org/bitstream>
- Halls, A. S. (2009). Addressing fisheries in the climate change and adaptation initiative. *Fisheries Research and Development. Melkong Region*, 15.
- Hamann, R., Smith, J., Tashman, P., & Marshall, R. S. (2017). Why Do SMEs Go Green? An Analysis of Wine Firms in South Africa. *Business & Society*, 56(1), 23–56. doi:10.1177/0007650315575106
- Hamed, A. (2021), Climate Change contributes to water scarcity, chapter 3, in Adaptation to a changing climate in the Arab countries, A case for adaptation. In Governance and Leadership in Building Climate Resilience. The World Bank.
- Hansen, J., Sato, M., Kharecha, P., Beerling, D., Berner, R., Masson-Delmotte, V., . . . Zacher, J. C. (2008). *Target atmospheric CO₂: Where should humanity aim?* arXiv preprint arXiv:0804.1126.
- Hanspal, T., Weber, A., & Wohlfart, J. (2020). Exposure to the COVID-19 stock market crash and its effect on household expectations. *The Review of Economics and Statistics*, 1–45. doi:10.1162/rest_a_01011
- Harduar Morano, L., Jagger, M. A., Barrett, E. C., Berisha, V., Borjan, M., & Heitziniger, K. (2017). CSTE Climate and Health Syndromic Surveillance Workshop. In *Syndromic surveillance climate and health guidance document*. Braintree, MA: International Society for Disease Surveillance.
- Harley, C. D. G., Randall Hughes, A., Hultgren, K. M., Miner, B. G., Sorte, C. J. B., Thornber, C. S., Rodriguez, L. F., Tomanek, L., & Williams, S. L. (2006). The impacts of climate change in coastal marine systems. *Ecology Letters*, 9(2), 228–241. doi:10.1111/j.1461-0248.2005.00871.x PMID:16958887
- Harrod, C. (2016). Climate change and freshwater fisheries. In J. F. Craig (Ed.), *Freshwater fisheries ecology* (pp. 641–694). John Wiley & Sons, Ltd., doi:10.1002/9781118394380.ch50
- Hart, S. (2005). Innovation, creative destruction and sustainability. *Research Technology Management*, 48(September-October), 21–27. doi:10.1080/08956308.2005.11657334
- Harvard Gazette. (2019). *Business opportunities from climate change: News from Harvard schools, offices, and affiliates*. Retrieved from <https://news.harvard.edu/gazette/story/newsplus/business-opportunities-from-climate-change/>
- Harvard School of Public Health. (2020). *Coronavirus and climate change*. Retrieved from <https://www.hsph.harvard.edu/c-change/subtopics/coronavirus-and-climate-change/>
- Harvey, F. (2015). *British belief in climate change on the rise, research finds*. Retrieved from: <https://www.theguardian.com/environment/2015/jan/29/british-belief-in-climate-change-at-highest-level-in-past-decade-survey>
- Hasan, Z., & Ali, N. A. (2015). The impact of green marketing strategy on the firms performance in Malaysia. *Procedia: Social and Behavioral Sciences*, 172, 463–470. doi:10.1016/j.sbspro.2015.01.382
- Hass, J. (1996). Environmental (green) management typologies: An evaluation, operationalization and empirical development. *Business Strategy and the Environment*, 5(2), 59–68. doi:10.1002/(SICI)1099-0836(199606)5:2<59::AID-BSE49>3.0.CO;2-W
- Hauke, E., Per-Anders, E., & Kimberly, H. (2015). *How companies can adapt to climate change: Taking effective action can turn risk into competitive advantage*. Retrieved from <https://www.mckinsey.com/business-functions/sustainability/our-insights/how-companies-can-adapt-to-climate-change#>

- Hawken, P. (1993). *The Ecology of Commerce: A Declaration of Sustainability*. Collins Business.
- Haworth, A., Frandon-Martinez, C., Fayolle, V., & Simonet, C. (2016). *Climate resilience and financial services*. Academic Press.
- Heal, G., & Milner, A. (2013). *Uncertainty and decision in climate change economics*. National Bureau of Economic Research Working Paper 18929.
- Healey, N. M. (2017). *Reflections on the value of insider research as a qualitative research methodology*. SAGE Publications Ltd. doi:10.4135/9781526401489
- Hebb, T., Hamilton, A., & Hachigian, H. (2010). Responsible property investing in Canada: Factoring both environmental and social impacts in the Canadian real estate market. *Journal of Business Ethics*, 92(1), 99–115. doi:10.1007/10551-010-0636-5
- Heberger, L., Kirsch, B., Donhauser, T., Nissle, S., Gurka, M., Schmeer, S., & Aurich, J. C. (2016). Influence of the quality of rivet holes in carbon-fiber-reinforced-polymer (CFRP) on the connection stability. *Procedia Manufacturing*, 6, 140–147. doi:10.1016/j.promfg.2016.11.018
- Hecht, S. B. (2007). Climate change and the transformation of risk: Insurance matters. *UCLA Law Review. University of California, Los Angeles. School of Law*, 55, 1559.
- Hegerl, G. C., Brönnimann, S., Cowan, T., Friedman, A. R., Hawkins, E., Iles, C., & Undorf, S. (2019). Causes of climate change over the historical record. *Environmental Research Letters*, 14(12), 123006. doi:10.1088/1748-9326/ab4557
- He, H., & Harris, L. (2020). The impact of Covid-19 pandemic on corporate social responsibility and marketing philosophy. *Journal of Business Research*, 116, 176–182. doi:10.1016/j.jbusres.2020.05.030 PMID:32457556
- Heiret, T. (2020). *The Impact of Climate Change Induced Resource Scarcity on Human Security: An Analysis of Experiences by Families in Lokichoggio, Turkana County, Kenya* (Doctoral dissertation). United States International University-Africa.
- Helmer, M., & Hilhorst, D. (2006). Natural disasters and climate change. In *Disasters* (Vol. 30, Issue 1). doi:10.1111/j.1467-9523.2006.00302.x
- Helms, C., Pölling, B., Curran, T., & Lorleberg, W. (2018). *Desktop research: national literature reviews and analyses of educational resources*. Academic Press.
- Hempson, G. P., Archibald, S., & Bond, W. J. (2017). The consequences of replacing wildlife with livestock in Africa. *Scientific Reports*, 7(1), 1–10. doi:10.1038/41598-017-17348-4 PMID:29222494
- Hendranata, I. G. Y. (2018). *Green sukuk for innovative infrastructure financing*. A material of presentation at Asian Regional Debt Management Forum.
- Herath, H. M., & Herath, H. (2019). Impact of green banking initiatives on customer satisfaction: A conceptual model of customer satisfaction on green banking. *OSR Journal of Business and Management*, 21(1), 24–35.
- Herrero, M., Thornton, P. K., Notenbaert, A., Msangi, S., Wood, S., Kruska, R., Dixon, J., Bossio, D., van de Steeg, J., Ade Freeman, H., & Li, X. (2012). Drivers of Change in Crop–Livestock Systems and Their Potential Impacts on Agro-Ecosystems Services and Human Wellbeing to 2030: A Study Commissioned by the CGIAR Systemwide Livestock Programme. International Livestock Research Institute, Nairobi, Kenya.

Compilation of References

- Herrero, M., Thornton, P. K., Notenbaert, A. M., Wood, S., Msangi, S., Freeman, H. A., Bossio, D., Dixon, J., Peters, M., van de Steeg, J., Lynam, J., Rao, P. P., Macmillan, S., Gerard, B., McDermott, J., Sere, C., & Rosegrant, M. (2010). Smart investments in sustainable food production: Revisiting mixed crop livestock systems. *Science*, *327*(5967), 822–825. doi:10.1126/science.1183725 PMID:20150490
- Hervé, A., Schmitt, C., & Baldegger, R. (2020). Digitalization, Entrepreneurial Orientation and Internationalization of Micro-, Small-and Medium-Sized Enterprises. *Technology Innovation Management Review*, *10*(4), 5–17. doi:10.22215/timreview/1343
- Herweijer, C., Ranger, N., & Ward, R. E. (2009). Adaptation to climate change: Threats and opportunities for the insurance industry. *The Geneva Papers on Risk and Insurance. Issues and Practice*, *34*(3), 360–380. doi:10.1057/gpp.2009.13
- Heslinga, J., Groote, P., & Vanclay, F. (2019). Strengthening governance processes to improve benefit-sharing from tourism in protected areas by using stakeholder analysis. *Journal of Sustainable Tourism*, *27*(6), 773–787. doi:10.1080/09669582.2017.1408635
- Higgins, C., Tang, S., & Stubbs, W. (2020). On managing hypocrisy: The transparency of sustainability reports. *Journal of Business Research*, *114*, 395–407. doi:10.1016/j.jbusres.2019.08.041
- Hillman, J. R., & Baydoun, E. (2020). An Overview of Innovation and Entrepreneurship to Address Climate Change. In *Higher Education in the Arab World* (pp. 141–181). Springer. doi:10.1007/978-3-030-37834-9_6
- Hirsh, R. F., & Koomey, J. G. (2015). Electricity consumption and economic growth: A new relationship with significant consequences. *The Electricity Journal*, *28*(9), 72–84. doi:10.1016/j.tej.2015.10.002
- Hoegh-Guldberg, O., Jacob, D., Taylor, M., Bolaños, T. G., Bindi, M., Brown, S., Camilloni, I. A., Diedhiou, A., Djalante, R., Ebi, K., & Engelbrecht, F. (2019). The human imperative of stabilizing global climate change at 1.5 C. *Science*, *365*(6459), eaaw6974. doi:10.1126/science.aaw6974 PMID:31604209
- Hofer, C., Eroglu, C., & Hofer, A. R. (2012). The Effect of Lean Production on Financial Performance: The Mediating Role of Inventory Leanness. *International Journal of Production Economics*, *138*(2), 242–253. doi:10.1016/j.ijpe.2012.03.025
- Hoff, H., Warner, K., & Bouwer, L. (2005). The role of financial services in climate adaptation in developing countries. *Deutsches Institut für Wirtschaftsforschung*, *74*(2), 196–207.
- Hoffman, A. J. (2010). Climate change as a cultural and behavioral issue: Addressing barriers and implementing solutions. *Organizational Dynamics*, *39*(4), 295–305. doi:10.1016/j.orgdyn.2010.07.005
- Holland, D., & Young, G. (2020). *The economic implications of climate change mitigation policies*. National Institute of Economic and Social Research., doi:10.1017/nie.2020.1
- Hoogendoorn, G., & Fitchett, J. M. (2018). Tourism and climate change: A review of threats and adaptation strategies for Africa. *Current Issues in Tourism*, *21*(7), 742–759. doi:10.1080/13683500.2016.1188893
- Hoogeveen. (2020). Forests and Climate Change: from complex problem to integrated solution. *UN Chronicle*. Accessed from <https://www.un.org>
- Horvat, R. & Korošec, B. (2015). The Role of Accounting in a Society: Only a technological solution for the problem of economic measurement or also a tool of social ideology? *Našegospodarstvo/Our Economy*, *61*(4), 32–40.
- Howard, A., & Hassler, M. (2018). Climate change: forgotten physical risks. *Schroders*.
- Hoyt, D. V., & Schatten, K. H. (1997). *The role of the sun in climate change*. Oxford University Press. doi:10.1093/oso/9780195094138.001.0001

- Hsiao, T.-Y., Chuang, C.-M., Kuo, N.-W., & Yu, S. M.-F. (2014). Establishing attributes of an environmental management system for green hotel evaluation. *International Journal of Hospitality Management*, 36, 197–208.
- Hsieh, Y. C. J. (2012). Hotel companies' environmental policies and practices: A content analysis of their web pages. *International Journal of Contemporary Hospitality Management*.
- Hsu, A. W., & Wang, T. (2013). Does the market value corporate response to climate change? *Omega*, 41(2), 195–206. doi:10.1016/j.omega.2011.07.009
- Huang, B., Punzi, M. T., & Wu, Y. (2019). Do Banks Price Environmental Risk? Evidence from a Quasi-Natural Experiment in the People's Republic of China. Asian Development Bank Institute.
- Huang, S. Y., Chiu, A. A., Chao, P. C., & Wang, N. (2019). The Application of Material Flow Cost Accounting in Waste Reduction. *Sustainability*, 11(5), 1270.
- Hummel, K., Schlick, C., & Fifka, M. (2019). The role of sustainability performance and accounting assurors in sustainability assurance engagements. *Journal of Business Ethics*, 154(3), 733–757.
- Hussain, M., Liu, G., Yousaf, B., Ahmed, R., Uzma, F., Ali, M. U., Ullah, H., & Butt, A. R. (2018). Regional and sectoral assessment on climate-change in Pakistan: Social norms and indigenous perceptions on climate-change adaptation and mitigation in relation to global context. *Journal of Cleaner Production*, 200, 791–808. doi:10.1016/j.jclepro.2018.07.272
- Hutchinson, D. S. (1995). Ethics. In J. Barnes (Ed.), *The Cambridge companion to Aristotle* (pp. 195–232). Cambridge University Press.
- IATP. (2009). *Agriculture and climate-the critical connection*. Institute for Agriculture and Trade Policy.
- IDRBT. (2013). *Green Banking for Indian Banking Sector*. Institute for Development and Research in Banking Technology, Hyderabad, India. [https://www.idrbt.ac.in/assets/publications/Best%20Practices/Green%20Banking%20Framework%20\(2013\).pdf](https://www.idrbt.ac.in/assets/publications/Best%20Practices/Green%20Banking%20Framework%20(2013).pdf)
- IFAD (International Fund for Agricultural Development). (2010). *Livestock and climate change*. <https://www.ifad.org/lrkm/events/cops/papers/climate.pdf>
- IFC. (2016). *Climate Investment Opportunities in Emerging Markets*. Retrieved from https://www.ifc.org/wps/wcm/connect/59260145-ec2e-40de-97e6-3aa78b82b3c9/3503-IFC-Climate_Investment_Opportunity-Report-Dec-FINAL.pdf?MOD=AJPERES&CVID=IBLd6Xq
- IFC. (2020). *Sustainable Banking Network*. ESG Resources for Companies. https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/company-resources/sustainable-finance/sbn
- Iizumi, T., & Ramankutty, N. (2015). How do weather and climate influence cropping area and intensity? *Global Food Security*, 4, 46–50. doi:10.1016/j.gfs.2014.11.003
- Ijasan, K., Ajibola, M., & Gaibee, K. (2016). The Case For Green Hotels: An Investigation Into The Outlook Of South African Business Travellers. *International Journal of Applied Environmental Sciences*, 11(3), 809–824.
- Ikpefan, O. A. (2013). *Challenges of public-private partnership in infrastructural financing in Nigeria*. Covenant University. Retrieved from <http://eprints.covenantuniversity.edu.ng/1330/1/models%20of%20ppp.pdf>
- IMF. (2015). Islamic finance: Opportunities, challenges, and policy options. International Monetary Fund (IMF) Staff Discussion Note SDN/15/05.
- Ingrid Goodspeed. (2020). Climate risk – now on the agenda of South African financial sector regulators. *SA Financial Regulation Journal*. Retrieved 22/01/2021 <http://financialregulationjournal.co.za/>

Compilation of References

Institute of Physics. (2018). *Rising sea level could cost the world \$14 trillion a year by 2100*. Report.

Institutional Investors Group on Climate Change. (2020). *Understanding physical climate risks and opportunities—a guide for investors*. Retrieved from <https://www.iigcc.org/download/understanding-physical-climate-risks-and-opportunities-a-guide-for-investors/?wpdmdl=3388&refresh=600fad28b8cd61611640104>

Insulated Products Corp. (2015). *5 Most temperature-sensitive products that require cold chain packaging*. Retrieved from <https://ipcpack.com/5-most-temperature-sensitive-products-require-cold-chain-packaging/>

Intergovernmental Panel on Climate Change (IPCC). (2001). *Summary for Policymakers*. IPCC.

Intergovernmental Panel on Climate Change (IPCC). (2002). *Climate Change and Biodiversity*. IPCC Technical Paper V.

Intergovernmental Panel on Climate Change (IPCC). (2007). *Impact, Adaptation and Vulnerability. Contribution of Working Group I of the Intergovernmental Panel on Climate Change (Third Assessment Report)*. Cambridge University Press.

Intergovernmental Panel on Climate Change (IPCC). (2018). *Global warming of 1.5 C*. https://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf

Intergovernmental Panel on Climate Change (IPCC). (2019). *IPCC special report on the ocean and cryosphere in a changing climate*. https://www.ipcc.ch/site/assets/uploads/sites/3/2019/11/03_SROCC_SPM_FINAL.pdf

Intergovernmental Panel on Climate Change Fifth Assessment Report (IPCC AR5). (2014). *Approved summary for policy makers*. Retrieved from: <https://www.ipcc.ch/report/ar5/>

Intergovernmental Panel on Climate Change. (2001). *Climatic Change*. Author.

International Association of Insurance Supervisors and Sustainable Insurance Forum. (2018). *Issue paper on climate change risks to the insurance sector*. https://www.unepfi.org/psi/wp-content/uploads/2018/08/IAIS_SIF_-Issues-Paperon-Climate-Change-Risks-to-the-Insurance-Sector.pdf

International Fund for Agricultural Development (IFAD). (2014). *Impact of climate change on fisheries and aquaculture in the developing world and opportunities for adaptation, fisheries thematic paper: Tool for project design*. Rome: IFAD.

International Labour Organisation (ILO). (2018). *The employment impact of climate change adaptation*. Available at: <https://www.ilo.org/wcmsp5/groups/public/>

International Monetary Fund (IMF). (2018). *World Economic Outlook*. IMF.

Investopedia (2020). *7 Ways Climate Change Affects Companies*. Available at: <https://www.investopedia.com/financial-edge/0210/7-ways-climate-change-affects-companies.aspx>

IPCC (Intergovernmental Panel on Climate Change). (2014). *Climate change 2014: synthesis report. Contribution of working groups I, II, and III to the fifth assessment report of the intergovernmental panel on climate change*. Geneva, Switzerland: IPCC. Available from: https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf

IPCC. (2013). *The Physical Science Basis: Working Group I. Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press.

IPCC. (2014). *Climate Change 2014—Impacts, Adaptation and Vulnerability: Regional Aspects*. Cambridge University Press.

IPCC. (2014). *Contribution of working group II to the fifth assessment report of the intergovernmental panel on climate change*. In *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects*. Retrieved from <https://www.ipcc.ch/report/ar5/wg2/>

- Ipinjolu, J. K., Magawata, I., & Shinkafi, B. A. (2013). Potential impact of climate change on fisheries and aquaculture in Nigeria. *Proceedings of 28th FISON annual conference*.
- Ipinjolu, J. K., Magawata, I., & Shinkafi, B. A. (2014). Potential impact of climate change on fisheries and aquaculture in Nigeria. *Su Ürünleri Dergisi*, 9(5), 338–344.
- Iqbal, M., Nisha, N., & Raza, S. (2017). Customers' perceptions of green banking: examining service quality dimensions in Bangladesh. *Green Business: Concepts, Methodologies, Tools, and Applications*, 1071-1090.
- Islam, M. S., & P. C. Das. (2013). Green Banking practices in Bangladesh. *IOSR Journal of Business and Management*, 8(3), 39-44.
- Islam, A., & Kamruzzaman, M. (2015). Green banking practices in Bangladesh. *IOSR Journal of Business and Management*, 14(4), 37–42.
- Isma'il, M., & Kersha, A. J. (2018). Assessment of the Environmental Effects of Flooding in Makurdi Area of Benue State, Nigeria. *Journal of Scientific Research and Reports*, 20(5), 1–11. <https://doi.org/10.9734/jsrr/2018/9848>
- Isma, R. (2010). *The management of liquidity risk in islamic banks: The case of Indonesia* (Doctoral thesis). Durham Islamic Finance Program (DIFP) School of Government and International Affairs, Durham University.
- Isma, R., & Musari, K. (2009a, April 1). Menggagas sukuk sebagai instrumen fiskal dan moneter. *Bisnis Indonesia Daily*, p. 4.
- Isma, R., & Musari, K. (2009b, April). Sukuk, menuju instrumen fiskal dan moneter. *SHARING Magazine*, 3(28).
- Isma, R., & Musari, K. (2009c, March 23). Sukuk menjawab resesi. *Republika Daily Newspaper*.
- IUCN. (2004). 2004 IUCN Red List Categories and Criteria. IUCN.
- Izugbara, C. O., & Umoh, J. O. (2004). Indigenous waste management practices among the Ngwa of Southeastern Nigeria: Some lessons and policy implications. *The Environmentalist*, 24(2), 87–92. doi:10.1007/10669-004-4799-4
- Jacklitsch, B., Williams, W. J., Musolin, K., Coca, A., Kim, J.-H., & Turner, N. (2016). *Criteria for a recommended standard: Occupational exposure to heat and hot environments; Revised criteria 2016*. National Institute for Occupational Safety and Health.
- Jackson, J. (2009). How risky are sustainable real estate projects? An evaluation of LEED and ENERGY STAR development options. *Journal of Sustainable Real Estate*, 1(1), 91–106. doi:10.1080/10835547.2009.12091790
- Jankovic, S., Persic, M., & Zanini, G. T. (2011). Framework for development of environmental management accounting in Croatian hospitality industry. *Sustainable Tourism: Socio-Cultural, Environmental and Economics Impact*, 121-135.
- Janković, S., & Krivačić, D. (2014). Environmental accounting as perspective for hotel sustainability: Literature review. *Tourism and Hospitality Management*, 20(1), 103–120.
- Janse van Rensburg, K., Brue, S., & McConnell, C. (2011). *Economics* (Southern African Edition). McGraw-Hill.
- Jarno, K. (2017). *Carbon funds in climate policy*. Warsaw: CeDeWu.
- Jasch, C. (2009). *Environmental and Material Flow Cost Accounting: Principles and Procedures* (Vol. 25). Academic Press.
- Jasch, C. (2006). How to perform an environmental management cost assessment in one day. *Journal of Cleaner Production*, 14(14), 1194–1213.

Compilation of References

- Jayabal, G., & Soundarya, M. (2016). Green Banking: As banks initiative for sustainable development. *International Journal of Management*, 7(7), 276–280.
- Jensen, M. C. (1994). Self-interest, altruism, incentives, and agency theory. *Journal of Applied Corporate Finance*, 7(2), 40–45. doi:10.1111/j.1745-6622.1994.tb00404.x
- Jere, M., Jere, A., & Aspeling, J. (2015). A study of small, medium, and micro-sized enterprise (smme) business owner and stakeholder perceptions of barriers and enablers in the South African retail sector. *Journal of Governance and Regulation*, 4(4), 620–630. doi:10.22495/jgr_v4_i4_c5_p7
- Jha, N., & Bhome, S. (2013). A study of green banking trends in India. *International Monthly Referred Journal of Research in Management and Technology*, 2, 127-132.
- JhaP.MittalS. (2020). Scope for Alternative Financing Options to Promote Financial Access to SMEs: Evidence from India. Available at SSRN: <https://ssrn.com/abstract=3753046> doi:10.2139srn.3753046
- Jin. (2010). *Financial Strategy to Accelerate Innovation for Green Growth*. Korea Capital Market Institute.
- Johnsson, F., Kjärstad, J., & Rootzén, J. (2019). The threat to climate change mitigation posed by the abundance of fossil fuels. *Climate Policy*, 19(2), 258–274. doi:10.1080/14693062.2018.1483885
- Jour, D. M. (2013). *Net interest margins and firm performance in developing countries: Evidence from Argentine commercial banks*. doi:10.1108/MRR-05-2012-0100
- Julià, M., Vanroelen, C., Bosmans, K., Van Aerden, K., & Benach, J. (2017). Precarious employment and quality of employment in relation to health and well-being in Europe. *International Journal of Health Services: Planning, Administration, Evaluation*, 47, 389–409.
- Ju, X., Ferreira, F. A., & Wang, M. (2020). Innovation, agile project management and firm performance in a public sector-dominated economy: Empirical evidence from high-tech small and medium-sized enterprises in China. *Socio-Economic Planning Sciences*, 72, 100779. doi:10.1016/j.seps.2019.100779
- Kahf, M. (1997). *Instruments of meeting budget deficit in islamic economy*. Research Paper No. 42 1417 H. Islamic Research and Training Institute (IRTI) - Islamic Development Bank (IDB), Jeddah.
- Kahn, M. E., Mohaddes, K., Ng, R. N., Pesaran, M. H., Raissi, M., & Yang, J. C. (2019). Long-term macroeconomic effects of climate change: A cross-country analysis (No. w26167). National Bureau of Economic Research.
- Kais, S. M., & Islam, M. S. (2016). Community capitals as community resilience to climate change: Conceptual connections. *International Journal of Environmental Research and Public Health*, 13(12), 1–16. doi:10.3390/ijerph13121211 PMID:27929448
- Kalikoski, D. C., Jentoft, S., Charles, A., Salazar Herrera, D., Cook, K., Béné, C., & Allison, E. H. (2018). Understanding the impacts of climate change for fisheries and aquaculture: applying a poverty lens. In *Impacts of climate change on fisheries and aquaculture: Synthesis of current knowledge, adaptation and mitigation options*. Documento técnico de pesca y acuicultura de la FAO no 627. Roma: FAO.
- Kalra, H., Hallegate, S., Lempert, R., Brown, C., Fozzard, A., & Gill, S. (2014). *Agreeing on robust decisions: New processes for decision making under uncertainty*. World Bank Research Working Paper 6906.
- Kaminski, J., Hopp, C., & Tykvová, T. (2019). New technology assessment in entrepreneurial financing—Does crowd-funding predict venture capital investments? *Technological Forecasting and Social Change*, 139, 287–302. doi:10.1016/j.techfore.2018.11.015

- Kannan, R., & Boie, W. (2003). Energy management practices in SME - Case study of a bakery in Germany. *Energy Conversion and Management*, 44(6), 945–959. doi:10.1016/S0196-8904(02)00079-1
- Kapoor, M. (2018, September 28). These people predicted the 2008 recession and were laughed at! *Business Today*. Retrieved from <https://www.businesstoday.in/top-story/these-people-predicted-the-2008-recession-and-were-laughed-at/story/283071.html>
- Karadag, H. (2015). The Role and Challenges of Small and Medium-sized Enterprises (SMEs) in Emerging Economies: An Analysis from Turkey. *Business and Management Studies*, 1(2), 179. doi:10.11114/bms.v1i2.1049
- Karayılan, E. (2014). *Examining the relationship between sustainable tourism policies and community participation from an institutional perspective in developing countries: The case of Turkey* (Unpublished Doctoral Thesis). Istanbul University, Istanbul.
- Karbonayakizi. (2020). *What is a Carbon Footprint?* <http://www.karbonayakizi.com/whatiscarbonfootprint.html>
- Kärnä, J., Hansen, E., & Juslin, H. (2003). Social responsibility in environmental marketing planning. *European Journal of Marketing*, 37(5/6), 848–871. doi:10.1108/03090560310465170
- Karsner, A. (2019). *Testimony before the house financial services subcommittee on national security*. International Development and Monetary Policy. <https://financialservices.house.gov/uploadedfiles/hhrg-116-ba10-wstate-karsnera-20190911.pdf>
- Kartha, S., Bhandari, P., van Schaik, L., Cornland, D., & Kjellen, B. (2006). *Adaptation as a strategic issue in the climate negotiations. European Climate Platform (ECP) Background paper no.4, European Climate Platform (ECP)*. Draft.
- Katz, J. A., & Green, R. P. (2018). *Entrepreneurial small business*. McGraw-Hill Education.
- Kauškalė, L., & Geipele, I. (2017). Integrated approach of real estate market analysis in sustainable development context for decision making. *Procedia Engineering*, 172, 505–512. doi:10.1016/j.proeng.2017.02.059
- Kearney, C., Hisrich, R., & Roche, F. (2008). A conceptual model of public sector corporate entrepreneurship. *The International Entrepreneurship and Management Journal*, 4(3), 295–313. doi:10.1007/11365-007-0048-x
- Keenan, J. M., Hill, T., & Gumber, A. (2018). Climate gentrification: From theory to empiricism in Miami-Dade County, Florida. *Environmental Research Letters*, 13(5), 054001. doi:10.1088/1748-9326/aabb32
- Keller, G. (2005). *Statistics for management and economics* (7th ed.). Thomson South-Western.
- Kemp, A. C., Dutton, A., & Raymo, M. E. (2015). Paleo constraints on future sea-level rise. *Current Climate Change Reports*, 1(3), 205–215. doi:10.1007/40641-015-0014-6
- Kenton, W. (2020). Yield on earning assets. *Corporate Finance & Accounting -Financial Ratios*. www.investopedia.com
- Kent, T., & Stone, D. (2007). The Body Shop and the Role of Design in Retail Branding. *International Journal of Retail & Distribution Management*, 35(7), 531–543. doi:10.1108/09590550710755912
- Kenya Private Sector Alliance. (2014). *Climate change and the energy and manufacturing sector*. Retrieved from <http://www.warmheartworldwide.org/environmental/progressnews>
- Khan, E. A., Royhan, P., Rahman, M. A., Rahman, M. M., & Mostafa, A. (2019). The Impact of Environmental Orientation on Small Firms' Business Performance: The Mediation of Green Marketing Mix and Eco-Labeling Strategies. *Sustainability, MDPI, Open Access Journal*, 12(1), 1–17. doi:10.3390/s12010221
- Khan, H., & Khan, I. (2012). From Growth to Sustainable Development in Developing Countries: A Conceptual Framework. *Environment and Ecology*, 3(1), 23–33.

Compilation of References

- Khan, I., Hou, F., & Le, H. P. (2021). The impact of natural resources, energy consumption, and population growth on environmental quality: Fresh evidence from the United States of America. *The Science of the Total Environment*, 754, 142222. doi:10.1016/j.scitotenv.2020.142222 PMID:32920417
- Khanna, M., Heng, L. L., & Chia, A. (2010). Measuring corporate environmental performance: a Delphi study on ranking environmental performance of companies in Singapore. In *Sustainability matters – Environmental Management in Asia* (pp. 63-82). Singapore: World Scientific Publishing Co. doi:10.1142/9789814322911_0003
- Khan, S. A. R. (2018). Introductory chapter: introduction of green supply chain management. In *Green Practices and Strategies in Supply Chain Management*. IntechOpen.
- Kharel, S., Kharel, S., Chaurasiya, N., Maharjan, S., & Rijal, C. (2019). Transparency and accountability in the Nepalese corporate sector: A critical assessment. *Quest Journal of Management and Social Sciences*, 1(1), 1–25. doi:10.3126/qjmss.v1i1.25972
- Kianto, A., Sáenz, J., & Aramburu, N. (2017). Knowledge-based human resource management practices, intellectual capital and innovation. *Journal of Business Research*, 81, 11–20. doi:10.1016/j.jbusres.2017.07.018
- Kiefer, M., Rodríguez-Guzmán, J., Watson, J., De Joode, B. V., Mergler, D., & Soares da Silva, A. (2016). Worker health and safety and climate change in the Americas: Issues and research needs. *Revista Panamericana de Salud Pública*, 40(3), 192–197. PMID:27991978
- Kılıç, M., & Kuzey, C. (2019). The effect of corporate governance on carbon emission disclosures. *International Journal of Climate Change Strategies and Management*, 11(1), 35–53. doi:10.1108/IJCCSM-07-2017-0144
- Kılıç, S. (2012). An ecological approach to the economic dimension of sustainable development concept. *Journal of I. U. Political Science*, 47, 2012–2226.
- Kim, C. (2008). Preparing for Climate Change: Insurance and Small Business. In *The Geneva Papers on Risk and Insurance* (Vol. 33, No. 1, pp. 110-116). Palgrave Macmillan. <https://www.jstor.org/stable/41952976>
- Kim, C. (2009). *Impacts and counter-measures of climate change in Korean agriculture*. Korean Research Report No 593. Korea Rural Economic Institute.
- Kim, S.-H., Lee, K., & Fairhurst, A. (2017). The review of “green” research in hospitality, 2000-2014. *International Journal of Contemporary Hospitality Management*.
- Kim, Y. J., Kim, W. G., Choi, H. M., & Phetvaroon, K. (2019). The effect of green human resource management on hotel employees’ eco-friendly behavior and environmental performance. *International Journal of Hospitality Management*, 76, 83–93. doi:10.1016/j.ijhm.2018.04.007
- King, A. D., Butler, A. H., Jucker, M., Earl, N. O., & Rudeva, I. (2019). Observed relationships between sudden stratospheric warmings and European climate extremes. *Journal of Geophysical Research, D, Atmospheres*, 124(24), 13943–13961. doi:10.1029/2019JD030480
- Klarin, T. (2018). The Concept of Sustainable Development: From its Beginning to the Contemporary Issues. *International Review of Economics and Business*, 21(1), 67–94. doi:10.2478/zireb-2018-0005
- Klassen, R. (2000). Environmental Issues and Operations Management. *Encyclopedia of Production and Manufacturing Management*, 187–192. doi:10.1007/1-4020-0612-8_298
- Kleindorfer, P., Singhal, K., & Wassenhove, N. (2005). Sustainable Operations Management. *Production and Operations Management*, 14(4), 482–492. doi:10.1111/j.1937-5956.2005.tb00235.x

- Klomp, J. (2014). Financial fragility and natural disasters: An empirical analysis. *Journal of Financial Stability*, 2014(13), 180–192. doi:10.1016/j.jfs.2014.06.001
- Knight, Z., & Ganguly, G. (2018). *Managing financial system stability and climate change-a preliminary guide*. HSBC Centre of Sustainable Finance.
- Knoflacher, H., & Vesile, E. O. (2011). Discussions on the Concept of Sustainable Transportation. *TMH*, 51-58. https://www.imo.org.tr/resimler/dosya_ekler/8a03dde7a90e701_ek.pdf?dergi=186
- Kogan, F., Guo, W., & Yang, W. (2020). Near 40-year drought trend during 1981-2019 earth warming and food security. *Geomatics, Natural Hazards & Risk*, 11(1), 469–490. doi:10.1080/19475705.2020.1730452
- Kokubu, K., & Kitada, H. (2015). Material flow cost accounting and existing management perspectives. *Journal of Cleaner Production*, 108, 1279–1288.
- Kompas, T., Pham, V. H., & Che, T. N. (2018). The effects of climate change on GDP by country and the global economic gains from complying with the Paris climate accord. *Earth's Future*, 6(8), 1153–1173. doi:10.1029/2018EF000922
- Kose, M. A., & Ohnsorge, F. (2019). *A decade after the global recession: Lessons and challenges for emerging and developing economies*. World Bank. doi:10.1596/32641
- Kożuch, B., & Sienkiewicz-Małyjurek, K. (2016). Inter-organisational coordination for sustainable local governance: Public safety management in Poland. *Sustainability*, 8(2), 123. doi:10.3390u8020123
- Kraus, S., Burtscher, J., Vallaster, C., & Angerer, M. (2018). Sustainable entrepreneurship orientation: A reflection on status-quo research on factors facilitating responsible managerial practices. *Sustainability*, 10(2), 444. doi:10.3390u10020444
- Krishnan, S. (2014). *The power of Mobile Banking: How to Profit from the revolution in retail financial services*. John Wiley & Sons. doi:10.1002/9781118932025
- Krueger, P., Sautner, Z., & Starks, L. T. (2020). The importance of climate risks for institutional investors. *Review of Financial Studies*, 33(3), 1067–1111. doi:10.1093/rfs/hhz137
- Krushelnyska, O. (2017). *Introduction to green finance*. Global Environment Facility. Retrieved from <https://www.thegef.org/sites/default/files/events/Intro%20to%20Green%20Finance.pdf>
- Kulp, S. A., & Strauss, B. H. (2019). New elevation data triple estimates of global vulnerability to sea-level rise and coastal flooding. *Nature Communications*, 10(1), 1–12. PMID:30602773
- Kumar, S., Kumar, N., & Vivekadhish, S. (2016). Millennium Development Goals (MDGs) to Sustainable Development Goals (SDGs): Addressing Unfinished Agenda and Strengthening Sustainable Development and Partnership. *Indian Journal of Community Medicine*, 41(1), 1–4. <https://doi.org/10.4103/0970-0218.170955>
- Kunreuther, H., Heal, G., Allen, M., Edenhofer, O., Field, C., & Yohe, G. (2012). *Risk management and climate change*. NBER Working Paper 18607.
- Kunreuther, H. (2006). Disaster mitigation and insurance: Learning from Katrina. *American Academy of Political and Social Science*, 604(1), 206–227. doi:10.1177/0002716205285685
- Kunreuther, H. C., & Michel-Kerjan, E. O. (2007). *Climate change, insurability of large-scale disasters and the emerging liability challenge*. National Bureau of Economic Research. doi:10.3386/w12821
- Kurland, N., & Zell, D. (2011). Green Management: Principles and Examples. *Organizational Dynamics*, 40(1), 49–56. doi:10.1016/j.orgdyn.2010.10.004

Compilation of References

- Kurukulasuriya, P., Mendelsohn, R., Hassan, J., Benhin, T., Deressa, M., Diop, H. M., Eid, H. M., Fosu, K. Y., Gbetibouo, G., Jain, S., Mahamadou, A., Mano, R., Kabubo-Mariara, J., El-Marsafawy, S., Molua, E., Ouda, S., Ouedraogo, M., Séne, I., Maddison, D., ... Dinar, A. (2006). Will African agriculture survive climate change. *The World Bank Economic Review*, 20(3), 367–388. doi:10.1093/wber/lhl004
- Kwong, J. (2005). Globalization's effects on the environment. *Society*, 42(2), 21–28. doi:10.1007/BF02687396
- Lagarde, C. (2020). *Climate change and the financial sector. At the launch of the COP 26 private finance agenda*. https://www.ecb.europa.eu/press/key/date/2020/html/ecb.sp200227_1~5eac0ce39a.en.html
- Lagarde, C. (2020). *Climate Change and the Financial Sector. Launch of COP 26 Private Finance Agenda*. <https://www.ecb.europa.eu>
- Lalon, R. M. (2015). Green Banking: Going Green. *International Journal of Economics, Finance and Management Sciences.*, 3(1), 34–42.
- Lamboll, R., & Nelson, V. (2012). *Exploring the linkages and guiding concepts relevant to climate change*. Agriculture and Development working paper No 2
- Lamb, W. F., & Steinberger, J. K. (2017). Human well-being and climate change mitigation. *Wiley Interdisciplinary Reviews: Climate Change*, 8(6), e485. doi:10.1002/wcc.485
- Larashati, H., Hudrasyah, H., & Chandra, N. (2012). *7Ps of green marketing as factors influencing willingness to buy towards environmentally friendly beauty products*. Academic Press.
- Lawrence, B., Doorasamy, M., & Sarpong, P. (2020). The Impact of Credit Risk on Performance: A Case of South African Commercial Banks. *Global Business Review*.
- Le Den, X., Beavor, E., Porteron, S., & Iliescu, A. (2017). *Analysis of the use of Auction Revenues by the Member States*. European Commission. Retrieved from https://ec.europa.eu/clima/sites/clima/files/ets/auctioning/docs/auction_revenues_report_2017_en.pdf
- Leboea, S. T. (2017). *The factors influencing SME failure in South Africa* (Master's thesis). University of Cape Town.
- Lee, B. X., Kjaerulf, F., Turner, S., Cohen, L., Donnelly, P. D., Muggah, R., Davis, R., Realini, A., Kieselbach, B., MacGregor, L. S., Waller, I., Gordon, R., Moloney-Kitts, M., Lee, G., & Gilligan, J. (2016). Transforming our world: Implementing the 2030 agenda through sustainable development goal indicators. *Journal of Public Health Policy*, 37(1), 13–31. doi:10.1057/41271-016-0002-7 PMID:27638240
- Lee, J. Y., & Lee, Y. (2018). Job crafting and performance: Literature review and implications for human resource development. *Human Resource Development Review*, 17(3), 277–313. doi:10.1177/1534484318788269
- Lee, J.-S., Hsu, L.-T., Han, H., & Kim, Y. (2010). Understanding how consumers view green hotels: How a hotel's green image can influence behavioural intentions. *Journal of Sustainable Tourism*, 18(7), 901–914.
- Lee, K. H. (2009). Why and how to adopt green management into business organizations? *Management Decision*, 47(7), 1101–1121. doi:10.1108/00251740910978322
- Lee, K. H. (2014). Globalization, green management and climate change in the Asia-Pacific economy. *Journal of Asia-Pacific Business*, 15(2), 101–104. doi:10.1080/10599231.2014.904180
- Lee, K. H., & Min, B. (2014). Globalization and carbon constrained global economy: A fad or a trend? *Journal of Asia-Pacific Business*, 15(2), 105–121. doi:10.1080/10599231.2014.904181

- Lee, S. Y., & Ahn, Y. H. (2019). Climate-entrepreneurship in response to climate change. *International Journal of Climate Change Strategies and Management*, 11(2), 235–253. doi:10.1108/IJCCSM-09-2017-0177
- Lee, S. Y., & Klassen, R. D. (2016). Firms' response to climate change: The interplay of business uncertainty and organizational capabilities. *Business Strategy and the Environment*, 25(8), 577–592. doi:10.1002/bse.1890
- Lele, S. (1991). Sustainable Development: A Critical Review. *World Development*, 19(6), 607–621. doi:10.1016/0305-750X(91)90197-P
- Lema, M. A., & Majule, A. E. (2009). Impacts of climate change, variability and adaptation strategies on agriculture in semi-arid areas of Tanzania; The case of Manyoni District in Singida Region, Tanzania. *African Journal of Environmental Science and Technology*, 3(8), 206–218. doi:10.5897/AJEST09.099
- Lenz, R. (2016). Peer-to-peer lending: Opportunities and risks. *European Journal of Risk Regulation*, 7(4), 688–700. doi:10.1017/S1867299X00010126
- Leonel, J. R. N., Catarina, I. R. M., Carlos, J. P. G., & Nuno, M. C. A. (2019). Forest Management and Climate Change Mitigation: A Review on Carbon Cycle Flow Models for the Sustainability of Resources. *Sustainability*, 11(19), 5276. doi:10.3390/s11195276
- Leonidou, C. N., Katsikeas, C. S., & Morgan, N. A. (2013). “Greening” the marketing mix: Do firms do it and does it pay off? *Journal of the Academy of Marketing Science*, 41(2), 151–170. doi:10.1007/11747-012-0317-2
- Lesk, C., Rowhani, P., & Ramankutty, N. (2016). Influence of extreme weather disasters on global crop production. *Nature*, 529(7584), 84–87. doi:10.1038/nature16467 PMID:26738594
- Levin, K. (2017). *Extreme Weather: What's Climate Change Got to Do With It?* Available at: <https://www.wri.org/blog/2017/09/extreme-weather-whats-climate-change-got-do-it>
- Levy, B. S., & Patz, J. A. (Eds.). (2015). *Climate change and public health*. Oxford University Press. doi:10.1093/med/9780190202453.001.0001
- Lewandowsky, S., Risbey, J., Smithson, M., Newell, B., & Hunter, J. (2014). Scientific uncertainty and climate change: Part 1, Uncertainty and unabated emissions. *Climatic Change*, 124(1-2), 21–37. doi:10.1007/10584-014-1082-7
- Libell, J. P. (2018). *Exploring Strategies and Sustainability of Small Business Owners in Bethel Park Pennsylvania* (Doctoral dissertation). Colorado Technical University.
- Lickorish, J. L., & Jenkins, C. L. (1997). *An Introduction to Tourism*. Heinemann.
- Lin, B., & Agyeman, S. D. (2020). Assessing Sub-Saharan Africa's low carbon development through the dynamics of energy-related carbon dioxide emissions. *Journal of Cleaner Production*, 274, 122676. doi:10.1016/j.jclepro.2020.122676
- Lincoln Lenderking, H., Robinson, S. A., & Carlson, G. (2020). Climate change and food security in Caribbean small island developing states: Challenges and strategies. *International Journal of Sustainable Development and World Ecology*, 1–8. doi:10.1080/13504509.2020.1804477
- Linden, E. (2014, June 16). How the Insurance Industry Sees Climate Change. *The Los Angeles Times*. Retrieved from <https://www.latimes.com/opinion/op-ed/la-oe-linden-insurance-climate-change-20140617-story.html>
- Lindsey, R. (2018). Climate change: global sea level. *ClimateWatch Magazine*. Available on: http://arizonaenergy.org/News_17/News_Sep17/ClimateChangeGlobalSeaLevel.html
- Lines, R. (2005). The structure and function of attitudes toward organizational change. *Human Resource Development Review*, 4(1), 8–32. doi:10.1177/1534484304273818

Compilation of References

- Linnenluecke, M. K., Birt, J., & Griffiths, A. (2015). The role of accounting in supporting adaptation to climate change. *Accounting and Finance*, 55(3), 607–625. doi:10.1111/acfi.12120
- Linnenluecke, M. K., Griffiths, A., & Winn, M. I. (2013). Firm and industry adaptation to climate change: A review of climate adaptation studies in the business and management field. *Wiley Interdisciplinary Reviews: Climate Change*, 4(2), 400. doi:10.1002/wcc.214
- Linnerooth-Bayer, J., Mechler, R., & Pflug, G. (2005). Refocusing disaster aid. *Science*, 309(5737), 1044–1046. doi:10.1126/science.1116783 PMID:16099976
- Linnerooth-Bayer, J., Warner, K., Bals, C., Höpfe, P., Burton, I., Loster, T., & Haas, A. (2009). *Insurance, developing countries and climate change*. The Geneva Papers on Risk and Insurance-I.
- Liu, L., Chu, J., Anderson, J. L., & Xu, J. (2020). Sustainability comparisons in the triple bottom line for Chinese fisheries. *Marine Policy*, 104259.
- Liverpool-Tasie, L. S. O., Sanou, A., & Tambo, J. T. (2018). Climate change adaptation among poultry farmers: Evidence from Nigeria. *Climatic Change*, 157(3-4), 527–544. doi:10.1007/10584-019-02574-8
- Li, X., Chow, K. H., Zhu, Y., & Lin, Y. (2016). Evaluating the impacts of high-temperature outdoor working environments on construction labor productivity in China: A case study of rebar workers. *Building and Environment*, 95, 42–52. doi:10.1016/j.buildenv.2015.09.005
- Locatelli, L., Guerrero, M., Russo, B., Martínez-Gomariz, E., Sunyer, D., & Martínez, M. (2020). Socio-economic assessment of green infrastructure for climate change adaptation in the context of urban drainage planning. *Sustainability*, 12(9), 3792.
- Löfgren, A., Burtraw, D., Wråke, M., & Malinovskaya, A. (2018). Distribution of Emissions Allowances and the Use of Auction Revenues in the European Union Emissions Trading System. *Review of Environmental Economics and Policy*, 12(2), 284–303. doi:10.1093/reep/rey012
- Lown, J. M. (2011). Development and validation of a financial self-efficacy scale. *Financial Counseling and Planning*, 22(2), 54.
- Lozo, S. (2019). *Nothing but the truth? Climate risk disclosure by US companies*. Harvard University Extension School ENVR S-599 Independent Research Capstone.
- Lubber, M. (2019). 30 Years Later, Investors Still Lead The Way On Sustainability. *Forbes*. <https://www.forbes.com/sites/mindylubber/2019/03/22/30-years-later-investors-still-lead-the-way-on-sustainability/?sh=7ecd051c580c>
- Luber, G., Knowlton, K., Balbus, J., Frumkin, H., Hayden, M., & Hess, J. (2014). Human health. In J. M. Melillo, T. C. Richmond, & G. W. Yohe (Eds.), *Climate change impacts in the United States: the third National Climate Assessment* (pp. 220–256). Academic Press.
- Luber, G., & Lemery, J. (2015). *Global climate change and human health: From science to practice*. Jossey-Bass.
- Lucato, W. C., Costa, E. M., & de Oliveira Neto, G. C. (2017). The environmental performance of SMEs in the Brazilian textile industry and the relationship with their financial performance. *Journal of Environmental Management*, 203, 550–556. doi:10.1016/j.jenvman.2017.06.028 PMID:28647218
- Lucchini, R. G., Hashim, D., Acquilla, S., Basanets, A., Bertazzi, P. A., Landrigan, P. J., & Todd, A. C. (2017). A comparative assessment of major international disasters: The need for exposure assessment, systematic emergency preparedness, and lifetime health care. *BMC Public Health*, 17(46), 46. doi:10.1186/12889-016-3939-3 PMID:28061835

- Lucier, A., Ayres, M., Karnosky, D., Thompson, I., Loehle, C., Percy, K., & Sohngen, B. (2009). Forest responses and vulnerabilities to recent climate change. In *Adaptation of forests and people to climate change*. IUFRO World Series 22.
- Ludwig, F. (2007). *Climate Change Impacts on Developing Countries-EU Accountability*. Policy Department Economic and Scientific Policy, European Parliament.
- Luomi, M. (2021). Climate Change Policy in the Arab Region. In *Low Carbon Energy in the Middle East and North Africa* (pp. 299–332). Palgrave Macmillan. doi:10.1007/978-3-030-59554-8_11
- Lu, W. Ye. M., Chau, K. W., & Flanagan, R. (2018). The paradoxical nexus between corporate social responsibility and sustainable financial performance: Evidence from the international construction business. *Corporate Social Responsibility and Environmental Management*, 25(5), 844–852. doi:10.1002/csr.1501
- Lymperopoulos, I. E., Chaniotakis, I. E., & Soureli, M. (2012). A model of green bank marketing. *Journal of Financial Services Marketing*, 17(2), 177–186. doi:10.1057/fsm.2012.10
- Lyon, T. P., & Montgomery, A. W. (2015). The means and end of greenwash. *Organization & Environment*, 28(2), 223–249. doi:10.1177/1086026615575332
- Maama, H. (2020). Institutional environment and environmental, social and governance accounting among banks in West Africa. *Meditari Accountancy Research*. doi:10.1108/MEDAR-02-2020-0770
- Macfadyen, G., & Allison, E. (2009). *Climate change, fisheries, trade and competitiveness: understanding impacts and formulating responses for Commonwealth small states*. Commonwealth Secretariat.
- Machado, C., Mattioda, R., Costa, S., Lima, E., & Winroth, M. (2018). *Developing capabilities for Sustainable Operations Management*. Conference Paper. https://research.chalmers.se/publication/505337/file/505337_Fulltext.pdf
- Machete, F., Hongoro, C., Nhamo, G., & Mearns, K. (2016). The use of environmental accounting to determine energy saving in Mpumalanga Hotels. Academic Press.
- MacKenzie, D. (2020). Pandemic warnings. *New Scientist*, 247(3300), 46–49. doi:10.1016/S0262-4079(20)31628-6
- MacWilliams, J., LaMonaca, S., & Kobus, J. (2019). *PG&E: Market and policy perspectives on the first climate change bankruptcy*. SIPA Centre on Global Energy Policy.
- Maduku, D. K., Mpinganjira, M., & Duh, H. (2016). Understanding mobile marketing adoption intention by South African SMEs: A multi-perspective framework. *International Journal of Information Management*, 36(5), 711–723. doi:10.1016/j.ijinfomgt.2016.04.018
- Makarenko, I., & Plastun, A. (2017). The role of accounting in sustainable development. *Accounting and Financial Control*, 1(2), 4–12. doi:10.21511/afc.01(2).2017.01
- Maksum, I. R., Sri Rahayu, A. Y., & Kusumawardhani, D. (2020). A social enterprise approach to empowering micro, small and medium enterprises (SMEs) in Indonesia. *Journal of Open Innovation*, 6(3), 50. Advance online publication. doi:10.3390/joitmc6030050
- Malliga, A. L., & Revathy, K. (2016). *Customers awareness on green banking- an initiative by private sector bank in Theni district*. Academic Press.
- Mamabolo, M. A., Kerrin, M., & Kele, T. (2017). Entrepreneurship management skills requirements in an emerging economy: A South African outlook. *Southern African Journal of Entrepreneurship and Small Business Management*, 9(1), a111. doi:10.4102ajesbm.v9i1.111

Compilation of References

- Manab, N., & Aziz, N. (2019). Integrating knowledge management in sustainability risk management practices for company survival. *Management Science Letters*, 9(4), 585–594. doi:10.5267/j.msl.2019.1.004
- Mandina, S. P., & Matsika, N. N. (2021). Consumer readiness to adopt self-service life assurance products. *British Journal of Management and Marketing Studies*, 4(1), 45–71.
- Manjunath, G., & Manjunath, G. (2013). Green Marketing and its Implementation in Indian Business Organizations. *Asia Pacific Journal of Marketing & Management Review*, 2(7), 75–86.
- Mann, M. E., & Kump, L. R. (2012). *An introduction to climate change*. Retrieved from <https://clean.ns.ca/climate-change-background-info/>
- Manokaran, K., Ramakrishnan, S., Hishan, S., & Soehod, K. (2018). The impact of corporate social responsibility on financial performance: Evidence from Insurance firms. *Management Science Letters*, 8(9), 913–932. doi:10.5267/j.msl.2018.6.016
- Marchewka-Bartkowiak, K. (2012). Wpływy budżetowe ze sprzedaży uprawnień do emisji gazów cieplarnianych w systemie ETS oraz możliwe warianty ich alokacji. *Studia BAS*, 29, 137-159. Retrieved from [http://orka.sejm.gov.pl/wydbas.nsf/0/9FC095BC342E685BC1257A2A0045B8BF/\\$File/Strony%20odStudiaBAS\(29\)_I-7.pdf](http://orka.sejm.gov.pl/wydbas.nsf/0/9FC095BC342E685BC1257A2A0045B8BF/$File/Strony%20odStudiaBAS(29)_I-7.pdf)
- Marcia, A., Maroun, W., & Callaghan, C. (2015). Value relevance and corporate responsibility in the South African context: An alternate view post King-III'. *Suid-Afrikaanse Tydskrif vir Ekonomiese en Bestuurswetenskappe*, 18(4), 500–519. doi:10.4102ajems.v18i4.1192
- MarketWatch. (2020). *Global waste-to-energy market to register 6.09% CAGR during 2019-2020*. Retrieved from <https://www.marketwatch.com/press-release/global-waste-to-energy-market-to-register-609-cagr-during-2019-2027-2020-11-26>
- Markolf, S. A., Hoehne, C., Fraser, A., Chester, M. V., & Underwood, B. S. (2019). Transportation resilience to climate change and extreme weather events—Beyond risk and robustness. *Transport Policy*, 74, 174–186. doi:10.1016/j.tranpol.2018.11.003
- Markoulli, M. P., Lee, C. I., Byington, E., & Felps, W. A. (2017). Mapping Human Resource Management: Reviewing the field and charting future directions. *Human Resource Management Review*, 27(3), 367–396. doi:10.1016/j.hrmr.2016.10.001
- Marks, J., & Hidden, K. (2017). *SMMEs and the Green Economy: Muddy waters and murky futures. An investigation into the sustainable practices of small medium and micro manufacturing enterprises in South Africa's Gauteng Province*. JP Morgan and Gordon Institute of Business Science.
- Marlon, J. R., Leiserowitz, A., & Feinberg, G. (2013). *Scientific and public perspectives on climate change*. Yale Project on Climate Change Communication, Yale University.
- Marota, R. (2017). Green concepts and material flow cost accounting application for company sustainability. *Indonesian Journal of Business and Entrepreneurship*, 3(1), 43–43.
- Marotzke, J. (2019). Quantifying the irreducible uncertainty in near term climate projections. *Wiley Interdisciplinary Reviews: Climate Change*, 10(1), 1–12. doi:10.1002/wcc.563
- Martín, C., McTarnaghan, S., & Williams, J.L. (2020). *Articulating a Program for Resilience*. Academic Press.
- Marushevskiy, G., & Hickman, D. (2017). *Green Business for Small and Medium-Size*. Academic Press.
- Massetti, E., & Mendelsohn, R. (2018). Measuring climate adaptation: Methods and evidence. *Review of Environmental Economics and Policy*, 12(2), 324–341. doi:10.1093/reep/rey007

- Masukujjaman, Md, Chamhuri, & Alam. (2015). Banker's perception on green banking-an empirical study on Islamic banks in Bangladesh. *Management & Marketing*, 8(2).
- Masukujjaman, M., & Aktar, S. (2013). Green banking in Bangladesh: A commitment towards the global. *Journal of Business and Technology (Dhaka)*, 8(1-2), 17–40. doi:10.3329/jbt.v8i1-2.18284
- Masuma, M. H., Hassanb, N., & Jahana, T. (2019). Corporate climate change reporting: Evidence from Bangladesh. *Accounting and Management Information Systems*, 18(3), 399–416. doi:10.24818/jamis.2019.03005
- Matata, A. C. & Adan, A. (2018). *Causes of climate change and its impact in the multi sectoral areas in Africa-Need for enhanced adaptation policies*. Academic Press.
- Mathu, K., & Tlare, M. T. (2017). The impact of IT adoption in SMEs supply chains: A case of Gauteng and Free State provinces of South Africa. *South African Journal of Business Management*, 48(3), 63–71. doi:10.4102ajbm.v48i3.36
- Matsumoto, K. I. (2018). Climate change impacts on socioeconomic activities through labor productivity changes considering interactions between socioeconomic and climate systems. *Journal of Cleaner Production*, 216, 528–541. doi:10.1016/j.jclepro.2018.12.127
- Matsumoto, K. I., Hasegawa, T., Morita, K., & Fujimori, S. O. (2019). Synergy potential between climate change mitigation and forest conservation policies in the Indonesian forest sector: Implications for achieving multiple sustainable development objectives. *Sustainability Science*, 14(6), 1657–1672. doi:10.1007/11625-018-0650-6
- Matuszak, Ł., & Róžańska, E. (2017). An examination of the relationship between CSR disclosure and financial performance: The case of Polish banks. *Accounting and Management Information Systems*, 16(4), 522–533. doi:10.24818/jamis.2017.04005
- May, B., & Plummer, R. (2011). Accommodating the challenges of climate change adaptation and governance in conventional risk management: Adaptive collaborative risk management. *Ecology and Society*, 16(1), 47. doi:10.5751/ES-03924-160147
- Mayring, P. (2014). *Qualitative content analysis: Theoretical foundation, basic procedures and software solution*. Klagenfurt, Austria: SSOAR. Retrieved from <https://www.ssoar.info/ssoar/handle/document/39517>
- Maziriri, E. T. (2020). Green packaging and green advertising as precursors of competitive advantage and business performance among manufacturing small and medium enterprises in South Africa. *Cogent Business & Management*, 7(1), 1719586. doi:10.1080/23311975.2020.1719586
- Mazzoleni, S., Turchetti, G., & Ambrosino, N. (2020). The COVID-19 outbreak: From “black swan” to global challenges and opportunities. *Pulmonology*, 26(3), 117–118. doi:10.1016/j.pulmoe.2020.03.002 PMID:32291202
- Mbalisi, O. F., & Offor, B. O. (2012). Imperatives of environmental education and awareness creation to solid waste management in Nigeria. *Academic Research International*, 3(2), 253–258.
- Mbasera, M., Du Plessis, E., Saayman, M., & Kruger, M. (2016). *Environmentally-friendly practices in hotels* (Vol. 16). Academic Press.
- Mbiti, I., & Weil, D. N. 2015. Mobile banking: The impact of M-Pesa in Kenya. In *African successes, volume III: Modernization and development* (pp. 247-293). University of Chicago Press.
- McAlpine, S. A., & Porter, J. R. (2018). Estimating recent local impacts of sea-level rise on current real-estate losses: A housing market case study in Miami-Dade, Florida. *Population Research and Policy Review*, 37(6), 871–895. doi:10.1007/11113-018-9473-5 PMID:30546178

Compilation of References

- McCarthy, T. (2014). *Meet the Republicans in Congress who don't believe climate change is real*. Retrieved from: <https://www.theguardian.com/environment/2014/nov/17/climate-changedenial-scepticism-republicans-congress>
- McDonald, J. R. (2006). *Understanding sustainable tourism development from a complex systems perspective: A case study of the Swan River, Western Australia* (Unpublished Doctoral Dissertation). Edith Cowan University, Australian.
- McGlade, C., & Ekins, P. (2015). The geographical distribution of fossil fuels unused when limiting global warming to 2°C. *Nature*, 517(7533), 187–190. doi:10.1038/nature14016 PMID:25567285
- McGuire, D. (2010). Engaging organizations in environmental change: A green print for action. *Advances in Developing Human Resources*, 12(5), 508–523. doi:10.1177/1523422310394759
- McGuire, J., Sundgren, A., & Schneeweis, T. (1988). Corporate social responsibility and firm financial performance. *Academy of Management Journal*, 31(4), 854–872.
- McIlvaine, B. (2007). By products can Make Coal Plants Green. *Power Engineering*, 38(42).
- McKibben, B. (2012). *The global warming reader: A century of writing about climate change*. Penguin.
- McKinsey & Company. (2020). *The five lessons from our annual Global Sustainability Summit*. Retrieved from: <https://www.mckinsey.com/business-functions/sustainability>
- McMichael, C., Dasgupta, S., Ayeb-Karlsson, S., & Kelman, I. (2020). A review of estimating population exposure to sea-level rise and the relevance for migration. *Environmental Research Letters*, 15(12), 123005. doi:10.1088/1748-9326/abb398
- Meadows, D.H., Meadows, D.L., Randers, J., & Behrens, W.W. (1972). *The limits to growth*. Academic Press.
- Mechler, R., Hochrainer, S., & Linnerooth-Bayer, J. (2006). Public sector financial vulnerability to disasters: The IIASA CATSIM model. In J. Birkmann (Ed.), *Measuring Vulnerability to Natural Hazards: Towards Disaster Resilient Societies*. UNU Press., doi:10.1057/gpp.2009.15
- Medugu, N. I. (2009). *Nigeria: Climate Change – A Threat to the Country's Development*. <https://www.allafrica.com/nigeria/>
- Mees, H. L., Uittenbroek, C. J., Hegger, D. L., & Driessen, P. P. (2019). From citizen participation to government participation: An exploration of the roles of local governments in community initiatives for climate change adaptation in the Netherlands. *Environmental Policy and Governance*, 29(3), 198–208. doi:10.1002/eet.1847
- Mehedi, S., & Kuddus, M. A. (2017). Green Banking: A case study on Dutch-Bangla bank Ltd. *Academy of Accounting and Financial Studies Journal*, 21(2), 1–20.
- Mehta & Sharma. (2016). Customers' persistence for green banking in Nepal. *Asian Journal of Research in Banking and Finance*, 6(10), 30-44.
- Mehta, L., Adam, H., & Srivastava, S. (2019). Unpacking uncertainty and climate change from above and below. *Regional Environmental Change*, 19(6), 1529–1532. doi:10.1007/10113-019-01539-y
- Melillo, J. M., Richmond, T. C., & Yohe, G. W. (2014). Climate change impacts in the United States: the third National Climate Assessment. *US Global Change Research Program*. Available at: <http://bit.ly/2014climate>
- Melissen, F., Cavagnaro, E., Damen, M., & Düweke, A. (2016). Is the hotel industry prepared to face the challenge of sustainable development? *Journal of Vacation Marketing*, 22(3), 227–238.

- Mendelsohn, R., Dinar, A., & Williams, L. (2006). The distributional impact of climate change on rich and poor countries. *Environment and Development Economics*, 11(2), 159-178.
- Menicucci, E., & Paolucci, G. (2016). The determinants of bank profitability: empirical evidence from European banking sector. *Journal of Financial Reporting and Accounting*, 14(1), 86-115.
- Mensah, J., & Casadevall, S. (2019). Sustainable development: Meaning, history, principles, pillars, and implications for human action: Literature review. *Cogent Social Sciences*, 5(1), 1653531. doi:10.1080/23311886.2019.1653531
- Mercure, J.-F., Pollitt, H., Viñuales, J. E., Edwards, N. R., Holden, P. B., Chewpreecha, U., Salas, P., Sognaes, I., Lam, A., & Knobloch, F. (2018). Macroeconomic impact of stranded fossil fuel assets. *Nature Climate Change*, 8(7), 588-593. doi:10.1038/41558-018-0182-1
- Merli, R., Preziosi, M., Acampora, A., & Ali, F. (2019). Why should hotels go green? Insights from guests experience in green hotels. *International Journal of Hospitality Management*, 81, 169-179.
- Methane, S. A. T. (2019). *MethaneSAT: Putting the brakes on climate change: Key technical considerations*. Retrieved from <https://www.edf.org/sites/default/files/MethaneSAT%20Technical%20considerations-May%202019.pdf>
- Mettler, T., & Wulf, J. (2019). Physiolytics at the workplace: Affordances and constraints of wearables use from an employee's perspective. *Information Systems Journal*, 29(1), 245-273. doi:10.1111/isj.12205
- Meyer, K. E., & Xin, K. R. (2018). Managing talent in emerging economy multinationals: Integrating strategic management and human resource management. *International Journal of Human Resource Management*, 29(11), 1827-1855. doi:10.1080/09585192.2017.1336362
- Michael, A. (2019). *A handbook of human resource management practice*. Academic Press.
- Michaels, A., Close, A., Malmquist, D., & Knap, A. (1997). Climate science and insurance risk. *Nature*, 389(6648), 225-227. doi:10.1038/38378
- Michalec, A., Fodor, M., Hayes, E., & Longhurst, J. (2018). Co-designing food waste services in the catering sector. *British Food Journal*.
- Miles-Novelo, A., & Anderson, C. A. (2019). Climate change and psychology: Effects of rapid global warming on violence and aggression. *Current Climate Change Reports*, 5(1), 36-46. doi:10.1007/40641-019-00121-2
- Mileti, D. (1999). *Disasters by design: A reassessment of natural hazards in the United States*. Joseph Henry Press.
- Millat, K. M., Chowdhury, R., & Singha, E. A. (2012). *Green Banking in Bangladesh: Fostering Environmentally Sustainable Inclusive Growth Process*. Bangladesh Bank. <http://www.bangladesh-bank.org/pub/special/greenbankingbd.pdf>
- Mills, E. (1998). *The Coming Storm Global Warming & Risk Management*. Available at: <https://eetd.lbl.gov/EMills/PUBS/comingstorm.html>
- Mills, E. (2005). Insurance in a climate of change. *Science*, 309(5737), 1040-1044. doi:10.1126/science.1112121 PMID:16099975
- Milstein, M. B., Hart, S. L., & York, A. S. (2002). Coercion breeds variation: The differential impact of isomorphic pressures on environmental strategies. In A. J. Hoffman & M. J. Ventresca (Eds.), *Organizations, policy, and the natural environment* (pp. 151-172). Stanford University Press.
- Mindra, R., Moya, M., Zuze, L. T., & Kodongo, O. (2017). Financial self-efficacy: A determinant of financial inclusion. *International Journal of Bank Marketing*, 35(3), 338-353. doi:10.1108/IJBM-05-2016-0065

Compilation of References

- Ministry of Cooperatives and Small and Medium Enterprises of the Republic of Indonesia. (2018). SMEs. *Data*, 2015–2018. <http://www.depkop.go.id/data-umkm>
- Ministry of Finance, Poland. (2014-2020). *State Budget Report*. Retrieved from <https://mf-arch2.mf.gov.pl/en/web/bip/ministry-of-finance/state-budget/revenue-expenditure-deficit-execution/>
- Mintrom, M., & Luetjens, J. (2017). Policy entrepreneurs and problem framing: The case of climate change. *Environment and Planning C. Politics and Space*, 35(8), 1362–1377.
- Miroshnychenko, Barontini, & Testa. (2017). *Green practices and financial performance: A global outlook*. Academic Press.
- Misati, E., Walumbwa, F. O., Lahiri, S., & Kundu, S. K. (2017). The internationalization of African small and medium enterprises (SMEs): A South-North pattern. *Africa Journal of Management*, 3(1), 53–81. doi:10.1080/23322373.2016.1275940
- Mishra, M. K., Choudhury, D., & Rao, V. G. (2019). Impact of Strategic and Tactical Green Marketing Orientation on SMEs Performance. *Theoretical Economics Letters*, 9(5), 1633–1650. doi:10.4236/tel.2019.95104
- Mishra, P. (2017). Green human resource management: A framework for sustainable organizational development in an emerging economy. *The International Journal of Organizational Analysis*, 25(5), 762–788. doi:10.1108/IJOA-11-2016-1079
- Misra, G. P., Kaushal, P., Bhaskarwar, A. K., & Grover, P. D. (2018). Requirement of pre-processing energy (WTE) plant based on Indian municipal solid waste (MSW). *Journal of Solid Waste Technology Management*, 44(2), 130–141. doi:10.5276/JSWTM.2018.130
- Mitchell, G. R. (2017). Climate change and manufacturing. *Procedia Manufacturing*, 12, 298–306. doi:10.1016/j.promfg.2017.08.033
- Mi, Z., Guan, D., Liu, Z., Liu, J., Viguié, V., Fromer, N., & Wang, Y. (2019). Cities: The core of climate change mitigation. *Journal of Cleaner Production*, 207, 582–589. doi:10.1016/j.jclepro.2018.10.034
- Mo, F., & Indonesia, U. N. D. P. (2018). Indonesia's green bond & green sukuk initiative. Jakarta: Ministry of Finance (MoF) Republic of Indonesia.
- MoF. (2019). Green sukuk, allocation and impact report – February 2019. Jakarta: Ministry of Finance (MoF) Republic of Indonesia.
- MoF. (2020). Green sukuk, allocation and impact report – March 2020. Jakarta: Ministry of Finance (MoF) Republic of Indonesia.
- Moghul, U. F., & Safar-Aly, S. H. K. (2014). Green sukuk: The introduction of Islam's environmental ethics to contemporary islamic finance. *Georgetown International Environmental Law Review*, 27(1), 1–60. doi:10.15408/etk.v19i1.13772
- Mokatsanyane, D. (2016). *The relationship between political risk, credit risk and profitability in the South African banking sector*. North-West University. Vaal Triangle Campus.
- Molia-Azorin, J., Claver-Cortes, E., Lopez-Gamero, M., & Tari, J. (2009). Green Management and Financial Performance: A Literature Review. *Management Decision*, 47(7), 1080–1100. doi:10.1108/00251740910978313
- Monnin, P. (2018). *Central banks should reflect climate risks in monetary policy operations*. SUERF Policy Note Issue No. 41.
- Montmasson-Clair, G., Mudombi, S., & Patel, M. (2019). Small business development in the climate change adaptation space in South Africa. *TIPS and Government of Flanders*. <https://www.tips.org.za/research-archive/sustainable-growth/green-economy-2/item/3621-small-business-development-in-the-climate-change-adaptation-space-in-south-africa>

- Moon, C.J., Walmsley, A. & Apostolopoulos, N. (2018). Governance implications of the UN higher education sustainability initiative. *Corporate Governance: The International Journal of Business in Society*.
- Moore, G., & Beadle, R. (2006). In search of organizational virtue in business: Agents, goods, practices, institutions and environments. *Organization Studies*, 27(3), 369–389. doi:10.1177/0170840606062427
- Moore, K. J., Qualls, W., Brennan, V., Yang, X., & Caban-Martinez, A. J. (2017). Mosquito control practices and Zika knowledge among outdoor construction workers in Miami-Dade County, Florida. *Journal of Occupational and Environmental Medicine*, 59, e17–e19.
- Morea, D., & Poggi, L. A. (2017). An innovative model for the sustainability of investments in the wind energy sector: The use of green sukuk in an Italian case study. *International Journal of Energy Economics and Policy*, 7(2), 53–60.
- Morrell, K. M., Loan-Clarke, J., & Wilkinson, A. J. (2004). Organisational change and employee turnover. *Personnel Review*, 32(2), 163–164.
- Morton, S., Pencheon, D., & Squires, N. (2017). Sustainable Development Goals (SDGs), and their implementation: A national global framework for health, development and equity needs a systems approach at every level. *British Medical Bulletin*, 1–10. doi:10.1093/bmb/ldx031 PMID:29069332
- Moskwa, E., Higgins-Desbiolles, F., & Gifford, S. (2015). Sustainability through food and conversation: The role of an entrepreneurial restaurateur in fostering engagement with sustainable development issues. *Journal of Sustainable Tourism*, 23(1), 126–14. doi:10.1080/09669582.2014.940046
- Mouratiadou, I., Biewald, A., Pehl, M., Bonsch, M., Baumstark, L., Klein, D., Popp, A., Luderer, G., & Kriegler, E. (2016). The impact of climate change mitigation on water demand for energy and food: An integrated analysis based on the Shared Socioeconomic Pathways. *Environmental Science & Policy*, 64, 48–58. doi:10.1016/j.envsci.2016.06.007
- Mousa, G., & Hassan, N. T. (2015). Legitimacy theory and environmental practices: Short notes. *International Journal of Business and Statistical Analysis*, 2(01).
- Mousa, S. K., & Othman, M. (2020). The impact of green human resource management practices on sustainable performance in healthcare organisations: A conceptual framework. *Journal of Cleaner Production*, 243, 118595. doi:10.1016/j.jclepro.2019.118595
- Moyer, J. D., & Hedden, S. (2020). Are we on the right path to achieve the sustainable development goals? *World Development*, 127, 104749. doi:10.1016/j.worlddev.2019.104749
- Moyo, M., & Wingard, H. C. (2015). An assessment of the impact of climate change on the financial performance of South African companies. *Journal of Governance and Regulation*, 4(2), 49–62. doi:10.22495/jgr_v4_i2_p5
- Muhammad, I. R. (2012). Climate change: A theoretical review. *Interdisciplinary Description of Complex Systems*, 11(1), 3. doi:10.7906/indcs.11.1.1
- Mukhtiyanto, I. (2019). Green sukuk: innovative financing schemes. A material of presentation at Country Showcase Pre 14th Islamic Financial Services Board (IFSB) Summit, Jakarta.
- Muldoon-Smith, K., & Greenhalgh, P. (2019). Suspect foundations: Developing an understanding of climate-related stranded assets in the global real estate sector. *Energy Research & Social Science*, 54, 60–67. doi:10.1016/j.erss.2019.03.013
- Müller, B. (2008). *To Earmark or Not to Earmark? A far-reaching debate on the use of auction revenue from (EU) Emissions Trading*. Oxford Institute for Energy Studies EV 43. Retrieved from <https://www.oxfordenergy.org/wpcms/wp-content/uploads/2011/03/EV43-ToEarmarkorNottoEarmarkAfar-reachingdebateontheuseofauctionrevenuefromEUEmissionsTrading-BMuller-2008.pdf>

Compilation of References

- Mumtaz, M., Puppim de Oliveira, J. A., & Ali, S. H. (2019). Climate change impacts and adaptation in the agricultural sector: the case of local responses. *Clim. Change Agric*, 1-14. doi:10.5772/intechopen.83553
- Munasinghe, M. (2002). The sustainomics trans-disciplinary meta-framework for making Development more sustainable: Applications to energy issues. *International Journal of Sustainable Development*, 4(2), 6–54. doi:10.1504/IJSD.2002.002563
- Munich Reinsurance Company. (2018). A Stormy Year: Natural Catastrophe 2017. Geo Risks Research. Munich: Munich Reinsurance Company.
- Murfin, J., & Spiegel, M. (2020). Is the risk of sea level rise capitalized in residential real estate? *Review of Financial Studies*, 33(3), 1217–1255. doi:10.1093/rfs/hhz134
- Muriithi, S. (2017). African small and medium enterprises (SMEs) contributions, challenges and solutions. *European Journal of Research and Reflection in Management Sciences*, 5(1), 36–48.
- Murray, A., Sinclair, D., Power, D., & Gray, R. (2006). Do financial markets care about social and environmental disclosure? Further evidence and exploration from the UK. *Accounting, Auditing & Accountability Journal*, 19(2), 228–255. doi:10.1108/09513570610656105
- Musari, K. (2013a). An analysis of the issuance of sovereign sukuk and its impact on the autonomy of state financial and well-being of society in the kingdom of Bahrain and Malaysia and republic of Indonesia (Doctoral thesis). Postgraduate Program, Airlangga University.
- Musari, K. (2019). The evolution of waqf and sukuk toward sukuk-waqf in modern islamic economy. *International Journal of 'Umranic Studies*, 2(1), 45-54.
- Musari, K. (2020a, January 7). Menakar peluang sukuk putih untuk SDGs. *Bisnis Indonesia Daily Newspaper*, p. 2.
- Musari, K. (2020b). *Cash waqf linked sukuk, a new blended finance of fiscal instrument for sustainable socio-economic development: Lesson learned from Indonesia*. A paper was presented at 12th International Conference on Islamic Economics and Finance (ICIEF) “Sustainable Development for Real Economy” with hosted by Istanbul Sabahattin Zaim University (IZU) and jointly organized by Islamic Research and Training Institute (IRTI) - Islamic Development Bank (IDB) and International Association of Islamic Economics (IAIE) with the collaboration of Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC) and Hamad Bin Khalifa University, Istanbul.
- Musari, K. (2020c, November 6). CWLS ritel, momentum kebaikan untuk semua. *Portal Jember, Pikiran Rakyat Media Network*. Retrieved from <https://portaljember.pikiran-rakyat.com/opini/pr-16917002/cwls-ritel-momentum-kebaikan-untuk-semua>
- Musari, K. (2020d, November 22). Paris agreement: Joe Biden, ekonomi syariah, dan adopsi hutan. *Portal Jember, Pikiran Rakyat Media Network*. Retrieved from <https://portaljember.pikiran-rakyat.com/opini/pr-16996041/paris-agreement-joe-biden-ekonomi-syariah-dan-adopsi-hutan>
- Musari, K. (2013b, June). Analysis of the influence of issuance of sovereign sukuk to the autonomy of state financial and well-being of society in the kingdom of Bahrain and the republic of Indonesia. *Australian Journal of Islamic Banking and Finance*, 2(1), 59–84.
- Mustapha, M. K. (2013). Potential Impacts of Climate Change on Artisanal Fisheries of Nigeria. *Journal of Earth Science & Climatic Change*, 4(130). Advance online publication. doi:10.4172/2157-7617.1000130
- Muthulingam, S. (2009). Environmental issues in operations management. *Dissertation Abstracts International*, 71(6), 2132–2221.

- Muthulingam, S., Corbett, C., Benartzi, S., & Oppenheim, B. (2013). Energy efficiency in small and medium-sized manufacturing firms: Order effects and the adoption of process improvement recommendations. *Manufacturing & Service Operations Management, 15*(4), 596–615. doi:10.1287/msom.2013.0439
- Muzenda, E. (2014). *A discussion on waste generation and management trends in South Africa*. Academic Press.
- Nabegu, A. B., & Ali, N. (2016). Climate change: the scientific basis, misconceptions, impacts and global response. *Environmental Pollution*. Retrieved from https://www.researchgate.net/publication/310844052_Climate_Change_the_scientific_basis_misconceptions_impacts_and_global_response
- Naden, C. (2021). *Assessing the risk of climate change*. Available at: <https://www.iso.org/news/ref2625.html>
- Nag, P. K., Dutta, P., & Nag, A. (2013). Critical body temperature profile as indicator of heat stress vulnerability. *Industrial Health, 51*, 113–122.
- Naidoo, R. & Fisher, B. (2020). *Reset sustainable development goals for a pandemic world*. Academic Press.
- Nakajima, M. (2010). *Environmental Management Accounting for Sustainable Manufacturing: Establishing Management System of Material Flow Cost Accounting*. MFCA.
- Nakhoda, S. (2010). *The clean technology fund: Insights for development and climate finance*. World Resource Institute (WRI) Working Paper. www.wri.org
- Nardone, A., Ronchi, B., Lacetera, N., Ranieri, M. S., & Bernabucci, U. (2010). Effects of climate change on animal production and sustainability of livestock systems. *Livestock Science, 130*(1-3), 57–69. doi:10.1016/j.livsci.2010.02.011
- Narteh, B., & Kuada, J. (2014). Customer satisfaction with retail banking services in Ghana. *Thunderbird International Business Review, 56*(4), 353–371. doi:10.1002/tie.21626
- Narváez, A. P., Riscanevo, K. A., & Guzmán, M. A. (2018). Environmental licenses. *Tékhné (Instituto Politécnico do Cávado e do Ave), 15*(2), 23–38.
- NASA. (2014). *What Is Climate Change?* Available at: <https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-climate-change-k4.html>
- NASA. (2021). *The Effects of Climate Change, Global Climate Change, Vital Signs of the Planet*. Accessed from <https://www.climate.nasa.gov>
- National Academies of Sciences, Engineering and Medicine. (2017). *Preparing for future products of biotechnology*. National Academies Press.
- National Aeronautics and Space Administration (NASA). (2021). *Responding to climate change*. Available at: <https://climate.nasa.gov/solutions/adaptation-mitigation/>
- National Geographic. (2019). *Climate Change*. Available at: <https://www.nationalgeographic.org/encyclopedia/climate-change/>
- National Institute for Occupational Safety and Health (NIOSH). (2018). *Emergency responder health monitoring and surveillance (ERHMS)*. Centers for Disease Control and Prevention.
- National Oceanic and Atmospheric Administration. (2021). *Billion dollar weather and climate disasters: overview*. <https://www.ncdc.noaa.gov/billions/>
- National Research Council. (2010). *Informing an Effective Response to Climate Change*. Washington, DC: The National Academies Press. doi:10.17226/12784

Compilation of References

- National Treasury Republic of South Africa. (2020). *A Technical Paper: Financing a Sustainable Economy*. Communication Directorate National Treasury. Retrieved 21/01/2021 Sustainability technical paper 2020.pdf
- National Treasury. (2018). *Explanatory memorandum on the carbon tax bill, 2018*. Retrieved from <http://www.treasury.gov.za/public%20comments/CarbonTaxBill2019/Explanatory%20Memorandum%20to%20the%202018%20Carbon%20Tax%20Bill%20-%2020%20Nov%202018.pdf>
- National Treasury. (2019). *Estimates of national expenditure. 2019 budget estimate for national expenditure*. Retrieved from <http://www.treasury.gov.za/documents/national%20budget/2019/enebooklets/Vote%2027%20Environmental%20Affairs.pdf>
- Nda, M., Adnan, M. S., Ahmad, K. A., Usman, N., Razi, M. A. M., & Daud, Z. (2018). A review on the causes, effects and mitigation of climate changes on the environmental aspects. *International Journal of Integrated Engineering*, 10(4). Advance online publication. doi:10.30880/ijie.2018.10.04.027
- NDIC. (2020). *Frequently Asked Questions*. <https://ndic.gov.ng/frequently-asked-questions/>
- Ndoka, S., & Islami, M. (2016). The Impact of Credit Risk Management in the Profitability of Albanian Commercial Banks During the Period 2005-2015. *European Journal of Sustainable Development*, 5(3), 445–452.
- Nduji, R., & Chris, O. (2020). Effect of e-commerce on performance of commercial banks in Nigeria (A case study of First Bank Plc, Bwari Area Council, Abuja). *Journal of African Studies and Sustainable Development*, 3(10).
- Nejati, M., Rabiei, S., & Jabbour, C. J. C. (2017). Envisioning the invisible: Understanding the synergy between green human resource management and green supply chain management in manufacturing firms in Iran in light of the moderating effect of employees' resistance to change. *Journal of Cleaner Production*, 168, 163–172. doi:10.1016/j.jclepro.2017.08.213
- Nerem, R. S., Beckley, B. D., Fasullo, J. T., Hamlington, B. D., Masters, D., & Mitchum, G. T. (2018). Climate-change-driven accelerated sea-level rise detected in the altimeter era. *Proceedings of the National Academy of Sciences of the United States of America*, 115(9), 2022–2025. doi:10.1073/pnas.1717312115 PMID:29440401
- Neri, A., Cagno, E., Lepri, M., & Trianni, A. (2020). *A triple bottom line balanced set of Key Performance Indicators to measure the sustainability performance of industrial supply chains*. Sustainable Production and Consumption.
- Network for the Greening Financial System. (2018). *NGFS First Progress Report*. <https://www.banque-france.fr/site/default/files/media/2018/10/11/818366-ngfsfirstprogress-report-20181011.pdf>
- Network for the Greening Financial System. (2018). *NGFS first progress report*. <https://www.banque-france.fr/sites/default/files/media/2018/10/11/818366-ngfs-first-progress-report-20181011.pdf>
- Network for the Greening Financial System. (2019). *A call for action: climate change as a financial risk*. [france.fr/sites/default/files/media/2019/04/17/ngfs_first_comprehensive_report_-_17042019_0.pdf](https://www.banque-france.fr/sites/default/files/media/2019/04/17/ngfs_first_comprehensive_report_-_17042019_0.pdf)
- Network for the Greening Financial System. (2019). *A Call for Action: Climate Change as a Financial Risk*. [Risk.rance.fr/sites/default/files/media/2019/04/17/ngfs_first_comprehensive_report_-_17042019_0.pdf](https://www.banque-france.fr/sites/default/files/media/2019/04/17/ngfs_first_comprehensive_report_-_17042019_0.pdf)
- Network of Central Banks and Supervisors for Greening the Financial System (NGFS). (2020). *Guide for Supervisors: Integrating Climate-Related and Environmental Risks into Prudential Supervision*. Available online: https://www.ngfs.net/sites/default/files/medias/documents/ngfs_guide_for_supervisors.pdf
- NFEP&WM. (2014-2020). *Sprawozdanie z działalności Narodowego Funduszu Ochrony Środowiska i Gospodarki Wodnej*. Retrieved from <https://www.nfosigw.gov.pl/o-nfosigw/organizacja-i-dzialalnosc/sprawozdania-z-dzialalnosci/>

- NGFS. (2019). *NGFS First Comprehensive Report. A Call for Action - Climate Change as a Source of Financial Risk*. Retrieved from <https://www.ngfs.net/en/first-comprehensive-report-call-action>
- Ngigi, S. N. (2009). *Climate change and adaptation strategies: water resources management options for small holder farming systems in Sub-Saharan Africa*. The MDG Centre for East and Southern Africa, The Earth Institute, Columbia University.
- Ngin, C., Chhom, C., & Neef, A. (2020). Climate change impacts and disaster resilience among micro businesses in the tourism and hospitality sector: The case of Kratie, Cambodia. *Environmental Research*, 186, 109557. doi:10.1016/j.envres.2020.109557 PMID:32334166
- Ngiatedema, T. (2014). Green Operations and Organisational performance. *International Journal of Business and Social Science*, 5(3), 50–58.
- Nhamo, G., Nhemachena, C., Nhamo, S., Mjimba, V., & Savić, I. (2020). Energy Poverty in the Midst of Plenty: A Harsh Reality for Sub-Saharan Africa. In *SDG7–Ensure Access to Affordable, Reliable, Sustainable, and Modern Energy*. Emerald Publishing Limited. doi:10.1108/978-1-78973-799-820201012
- Nidumolu, R., Ellison, J., Whalen, J., & Billman, E. (2014). The collaboration imperative. *Harvard Business Review*, 92(4), 76–84. PMID:24830283
- Niedziolka, I. (2014). Sustainable Tourism Development. *Regional Formation and Development Studies*, 3(8), 157–166.
- Nigeria, S. E. C. (2018). *The Securities And Exchange Commission (SEC) Nigeria Launches Green Bond Rules*. Press Release. <https://sec.gov.ng/the-securities-and-exchange-commision-sec-nigeria-launches-green-bond-rules/>
- Nigerian Sustainable Banking Principles. (2012). <https://www.cbn.gov.ng/out/2012/ccd/circular-nsbp.pdf>
- Nikolaou, I. E., Nikolaidou, M. K., & Tsagarakis, K. P. (2016). The response of small and medium-sized enterprises to potential water risks: An eco-cluster approach. *Journal of Cleaner Production*, 112, 4550–4557. doi:10.1016/j.jclepro.2015.09.068
- Nisanci, D. A. (2021). Case Studies of Climate Risk, Action, and Opportunity. In *World Scientific Encyclopedia of Climate Change* (Issue Volume 3, p. 364). World Scientific. doi:<https://doi.org/10.1142/11526-vol3>
- Nkechi, O. (2016). Mitigating climate change in Nigeria: African traditional religious values in focus. *Mediterranean Journal of Social Sciences*, 7(6), 299–308. <https://www.mcser.org/journal/index.php/mjss/article/view/9612>
- Nogueira, S. (2020). The importance of a green marketing strategy in brand communication-M. Coutinho multi-brand car dealer case in Northern Portugal. *Economics Business and Organization Research*, 351-373.
- Noh, H. J. (2010). *Strategies of Developing Green Finance*. Seoul: Korea Capital Market Institute (KCMi). <https://www.adb.org/sites/default/files/publication/452656/adbi-wp866.pdf>
- Nordhaus, W. (2019). Climate change: The ultimate challenge for economics. *The American Economic Review*, 109(6), 1991–2014. doi:10.1257/aer.109.6.1991
- Nordhaus, W. (2020). The climate club. *Foreign Affairs*.
- Noth, F., & Schüwer, U. (2018). *Natural Disaster and Bank Stability: Evidence from the US Financial System*. State Administration of Foreign Exchange.
- NRB. (2020). *Financial Stability Report, Fiscal Year 2018/19. Kathmandu, Nepal: Banks and Financial Institutions Regulation*. Department Financial Stability Unit, Nepal Rastra Bank. <https://www.nrb.org.np/contents/uploads/2020/07/FSR-2018-19.pdf>

Compilation of References

- Ntanos, S., Kyriakopoulos, G. L., Arabatzis, G., Palios, V., & Chalikias, M. (2018). Environmental behavior of secondary education students: A case study at central Greece. *Sustainability*, *10*(5), 1663. doi:10.3390/s10051663
- Nulkar, G. (2014). SMEs and Environmental Performance – A Framework for Green Business Strategies. *Procedia: Social and Behavioral Sciences*, *133*, 130–140. doi:10.1016/j.sbspro.2014.04.177
- Nulkar, G. (2018). Environmental sustainability practices for SMEs. In K. Paul, K. Bhattacharyya, & S. Anand (Eds.), *Green Initiatives for Business Sustainability and Value Creation*. IGI Global. doi:10.4018/978-1-5225-2662-9.ch001
- Nuryakin, N., & Maryati, T. (2020). Green product competitiveness and green product success. Why and how does mediating affect green innovation performance? *Entrepreneurship and Sustainability Issues*, *7*(4), 3061–3077. doi:10.9770/jesi.2020.7.4(33)
- Nwosu, C. C., & Ogbu, C. C. (2011). Climate change and livestock production in Nigeria: Issues and concerns. *Agro-Science J Trop Agri, Food. Environ Extension*, *10*, 41–60.
- Nwoye, I. S. (2019). *UNEP-FI Principles for Responsible Banking and The CBN Code of Corporate Governance: Improving on the Corporate Governance Discourse in Nigeria*. <https://ssrn.com/abstract=3471431>
- Nyamrunda, F., & Freeman, S. (2021). Small and Medium Enterprises in Transitional East African Economies: The Case of Tanzania. In *Doing Business in Africa* (pp. 277-307). Palgrave Macmillan.
- Nyide, C. J. (2016a). *A critical evaluation of environmental management accounting (EMA) tools used by 3-5 star hotels in KwaZulu-Natal*. Academic Press.
- Nyide, C. J. (2016b). *Material flow cost accounting as a tool for improved resource efficiency in the hotel sector: a case of emerging market*. Academic Press.
- Nyide, C. J., & Lekhanya, L. M. (2016). *Environmental management accounting practices: major control issues*. Academic Press.
- Nyide, C. J. (2019). Better resource management: A qualitative investigation of Environmental Management Accounting practices used by the South African hotel sector. *African Journal of Hospitality, Tourism and Leisure*, *8*(4). https://www.ajhtl.com/uploads/7/1/6/3/7163688/article_56_vol_8_4__2019_dut.pdf
- Nyika, J. (2020). Climate change situation in Kenya and measures towards adaptive management in the water sector. *International Journal of Environmental Sustainability and Green Technologies*, *11*(2), 34–47. doi:10.4018/IJESGT.2020070103
- Nyika, J. (2021). Climate change on fertility and reproductive processes of female livestock. In A. Wani & N. Naha (Eds.), *Climate change and its impact on fertility*. IGI Global. doi:10.4018/978-1-7998-4480-8.ch013
- Nylund, P. A., Brem, A., & Agarwal, N. (2021). Innovation ecosystems for meeting sustainable development goals: The evolving roles of multinational enterprises. *Journal of Cleaner Production*, *281*, 125329. doi:10.1016/j.jclepro.2020.125329
- O'Donohue, W., & Torugsa, N. (2016). The moderating effect of 'Green'HRM on the association between proactive environmental management and financial performance in small firms. *International Journal of Human Resource Management*, *27*(2), 239–261. doi:10.1080/09585192.2015.1063078
- O'Dwyer, B., & Unerman, J. (2020). Shifting the focus of sustainability accounting from impacts to risks and dependencies: Researching the transformative potential of TCFD reporting. *Accounting, Auditing & Accountability Journal*, *33*(5), 1113–1141. doi:10.1108/AAAJ-02-2020-4445
- O'Reilly, A. (1986). Tourism Carrying Capacity. *Tourism Management*, *7*(4), 146–225. doi:10.1016/0261-5177(86)90035-X
- Occupational Safety and Health Administration (OSHA). (2018). *Emergency preparedness and response*. Author.

- Odjugo, A. O. P., & Isi, A. I. (2003). The impact of climate change and anthropogenic factors on desertification in the semi-arid region of Nigeria. *Global Journal of Environmental Sciences*, 2(2), 118–127. doi:10.4314/gjes.v2i2.2418
- OECD. (2009). *Sustainable manufacturing and eco-innovation: towards a green economy*. Policy Brief. OECD.
- OECD. (2018). *SME and Entrepreneurship Policy in Indonesia 2018*. OECD.
- Ogbuabor, J.E. (2017). *The impact of climate change on the Nigerian economy*. Academic Press.
- Oghojafor, B. E. A., & Aduloju, S. A. (2020). Adoption of Voluntary Global Governance Initiatives: Equator Principles and Banks in Nigeria. *Economics and Organization*, 17(3), 249–260. doi:10.22190/FUEO200416016O
- Ogundiran, O. O., & Afolabi, T. A. (2008). Assessment of the physicochemical parameters and heavy metals toxicity of leachates from municipal solid waste open dumpsite. *International Journal of Environmental Science and Technology*, 5(2), 243–250. doi:10.1007/BF03326018
- Oguntala, A. B., Soladoye, M. O., Ugbogu, O. A., & Fashola, A. T. (1996). A review of endangered tree species of Cross River State and Environs. Academic Press.
- Oguntuase, O. J., & Ajibare, A. O. (2018). *Leveraging monetary policy and banking regulation for climate action in Nigeria* (No. 89611; Issue 89611). <https://mpa.ub.uni-muenchen.de/89611/>
- Oguntuase, O. (2020). *Climate change, credit risk, and financial stability*. IntechOpen. doi:10.5772/intechopen.93304
- Oguntuase, O. J. (2017). Climate change as financial risk: a survey of bank employees' perception in Nigeria. In G. A. Ajewole & B. Adegbamigbe (Eds.), *Proceedings of Adeniran Ogunsanya College of ...* (pp. 28–36). https://www.researchgate.net/profile/Oluwaseun_Oguntuase/publication/324694786_Climate_change_as_financial_risk_a_survey_of_bank_employees'_perception_in_Nigeria/links/5addbbeaaca272fdaf870917/Climate-change-as-financial-risk-a-survey-of-bank-employees-pe
- Oh, C. H., & Reuveny, R. (2010). Climatic Natural Disaster, Political Risk and International Trade. *Global Environmental Change*, 20(2), 243–254. doi:10.1016/j.gloenvcha.2009.11.005
- Ohlson, J. A. (1995). Earnings, Book Values, and Dividends in Equity Valuation. *Contemporary Accounting Research*, 11(2), 661–687. doi:10.1111/j.1911-3846.1995.tb00461.x
- Okezie, C. R., & Anurigwo, E. C. (2016). Fish Farmers Adaptive Capacities to Climate Change, in Port Harcourt Riverine Areas of Rivers State, Nigeria. *International Journal of Agriculture and Earth Science*, 2(4), 66–73.
- Okoli, J. N., & Ifeakor, A. C. (2014). An overview of climate change and food security: Adaptation strategies and mitigation measures in Nigeria. *Journal of Education and Practice*, 5(32).
- Okonjo-Iweala, N. (2020). *Africa can play a leading role in the fight against climate change*. Brookings: Foresight Africa 2020. <https://www.brookings.edu/research/africa-can-play-a-leading-role-in-the-fight-against-climate-change/#footnote-10>
- Okumus, F., Köseoglu, M. A., Chan, E., Hon, A., & Avci, U. (2019). How do hotel employees' environmental attitudes and intentions to implement green practices relate to their ecological behavior? *Journal of Hospitality and Tourism Management*, 39, 193–200.
- Olaniyi, O. A., Olutimehin, I. O., & Funmilayo, O. A. (2019). Review of Climate Change and Its effect on Nigeria Ecosystem. *International Journal of Rural Development*. *Environment and Health Research*, 3(3), 92–100. doi:10.22161/ijreh.3.3.3
- Oli, G. S., & Chhetri, B. B. (2015). *Hotel Management*. Buddha publications.

Compilation of References

- Olmos, L., Ranci, P., Pazienza, M. G., Ruester, S., Sartori, M., Galeotti, M., & Glachant, J. M. (2011). *The impact of climate and energy policies on the public budget of EU member states, Final Report*. Think. Retrieved from <https://op.europa.eu/en/publication-detail/-/publication/f42f283e-8d56-49e4-8ca8-c95e7bddaa5c/language-en>
- Oluowo, E. F. (2017). Impact of climate change on aquaculture and fisheries in Nigeria: A review. *International Journal of Multidisciplinary Research and Development*, 4(1), 53–59.
- Oluwaseyi, O. A. (2018). Climate Change and its Effect on the Global Economy and Security: A Call for more Robust Climate Finance, Prevention of Climate Finance Against Corrupt Spending and Review of Articles 9 (1), (3) & (4) of the Paris Agreement and 12 (8) of Kyoto Protocol to the United Nations Framework Convention on Climate Change. *Environment Pollution and Climate Change.*, 02(03). Advance online publication. doi:10.4172/2573-458X.1000157
- Oluwatobi, A. A., Mutalib, H. A., Adeniyi, T. K., Olabode, J. O., & Adeyemi, A. (2017). *Possible aquaculture development in Nigeria: evidence for commercial prospects*. Academic Press.
- Onwuamaeze, D. (2020, December 15). SERAS Awards: Zenith Bank Boss, Onyeagwu, Emerges CEO of the Year. *ThisDay*. <https://www.thisdaylive.com/index.php/2020/12/15/seras-awards-zenith-bank-boss-onyeagwu-emerges-ceo-of-the-year/>
- Onyekuru, A. N., & Marchant, R. (2014). *Climate change impact and adaptation pathways for forest dependent livelihood systems in Nigeria*. doi:10.5897/AJAR2013.8315
- Onyekuru, N. A., & Marchant, R. (2016). Agricultural and Forest Meteorology Assessing the economic impact of climate change on forest resource use in Nigeria: A Ricardian approach. *Agricultural and Forest Meteorology*. Elsevier B., 220, 10–20. doi:10.1016/j.agrformet.2016.01.001
- Oo, H. T., Zin, W. W., & Kyi, C. C. T. (2019). Assessment of future climate change projections using multiple global climate models. *Civil Engineering Journal*, 5(10), 2152–2166. doi:10.28991/cej-2019-03091401
- Osemeobo, G. J. (2005). Living on Wild Plants: Evaluation of the Rural Household Economy in Nigeria. *Environmental Practice*, 7(04), 246–256. doi:10.1017/S1466046605050386
- Oserogho, I. F. A. (2020). Extent of Environmental Disclosure of Listed Non-Financial Firms in Nigeria: Does Board Characteristics Matter? *Ilorin Journal of Human Resource Management*, 4(1), 215–226.
- Osueke, C. O., & Ezech, C. T. (2011). Assessment of Nigeria power sub-sector and electricity generation projections. *International Journal of Scientific and Engineering Research*, 2(11), 1–7.
- Oteh, A., & Sanni, T. F. (2021). *Africa Investment Roundtable - Sustainability En route to COP26*. Youtube. <https://www.youtube.com/watch?v=IIPxDSrHkKU>
- Öter, Z. (2007). Turizmde ulaştırma. In Genel turizm. Turhan Publishing.
- Ottman, J. (2011). *The new rules of green marketing: Strategies, tools, and inspiration for sustainable branding*. Berrett-Koehler Publishers.
- Owusu, P. A., & Asumadu-Sarkodie, S. (2016). A review of renewable energy sources, sustainability issues and climate change mitigation. *Cogent Engineering*, 3(1), 1167990. doi:10.1080/23311916.2016.1167990
- Özdemir, S. B. (2007). *The importance of carrying capacity in the balance of protecting and using environment: Sample tourism sector* (Unpublished Master's Thesis). Ankara University, Ankara.
- Ozili, P. K. (2020). Effect of climate change on financial institutions and the financial system. In *Uncertainty and Challenges in Contemporary Economic Behaviour*. Emerald Publishing Limited. doi:10.1108/978-1-80043-095-220201011

- Ozordi, E., Eluyela, D. F., Uwuigbe, U., Uwuigbe, O. R., & Nwaze, C. E. (2020). Gender diversity and sustainability responsiveness: Evidence from Nigerian fixed money deposit banks. *Problems and Perspectives in Management*, 18(1), 119–129. [https://doi.org/10.21511/ppm.18\(1\).2020.11](https://doi.org/10.21511/ppm.18(1).2020.11)
- Paillé, P., Chen, Y., Boiral, O., & Jin, J. (2014). The impact of human resource management on environmental performance: An employee-level study. *Journal of Business Ethics*, 121(3), 451–466. doi:10.1007/10551-013-1732-0
- Pakmehr, S., Yazdanpanah, M., & Baradaran, M. (2020). How collective efficacy makes a difference in responses to water shortage due to climate change in southwest Iran. *Land Use Policy*, 99, 104798. doi:10.1016/j.landusepol.2020.104798
- Pampanelli, A., Found, P., & Bernardes, A. (2015). Sustainable Manufacturing: The Lean and Green Business Model. In A. Chiarini (Ed.), *Sustainable Operations Management: Advances in Strategy and Methodology*. Springer. doi:10.1007/978-3-319-14002-5_7
- Panda, S., & Dash, S. (2014). Constraints faced by entrepreneurs in developing countries: A review and assessment. *World Review of Entrepreneurship, Management and Sustainable Development*, 10(4), 405–421. doi:10.1504/WREMSD.2014.064951
- Pane-Haden, S., Oyler, J., & Humphreys, J. (2009). Historical, practical, and theoretical perspectives on green management. *Management Decision*, 47(7), 1041–1055. doi:10.1108/00251740910978287
- Pan, S. Y., Mengyao, G., Kim, H., Shah, K. J., Pei, S. L., & Chiang, P. C. (2018). Advances and challenges in sustainable tourism toward a green economy. *The Science of the Total Environment*, 635, 452–469. doi:10.1016/j.scitotenv.2018.04.134 PMID:29677671
- Papadas, K.-K., Avlonitis, G. J., Carrigan, M., & Piha, L. (2019). The interplay of strategic and internal green marketing orientation on competitive advantage. *Journal of Business Research*, 104, 632–643. doi:10.1016/j.jbusres.2018.07.009
- Parajuli, S., Paudel, U. R., & Devkota, N. (2020). Banking Communications: A Perceptual Study of Customer Relations. *South Asian Journal of Social Studies and Economics*, 8(3), 23–34. doi:10.9734/ajsse/2020/v8i330212
- Parajuli, S., Rajbhandari, S., Joshi, A., Sujan, K., & Bhandari, U. (2019). Transforming corporate governance through effective corporate social responsibility (CSR) and social entrepreneurship orientation in Nepal. *Quest Journal of Management and Social Sciences*, 1(1), 26–49. doi:10.3126/qjmss.v1i1.25973
- Parasuraman, A., Berry, L., & Zeithaml, V. (1991). Understanding customer expectations of service. *Sloan Management Review*, 32(3), 39–48.
- Pariag-Maraye, N., Munusami, N., & Ansaram, K. (2017). A customer's perspective of green banking: A case study of commercial banks in Mauritius. *Theoretical Economics Letters*, 7(07), 19–75. doi:10.4236/tel.2017.77134
- Paris Agreement climate pledges. (n.d.). Retrieved from: https://www.eurekalert.org/pub_releases/2019-11/tca-ttb110119.php
- Park, D. B., & Yoon, Y. S. (2011). Developing Sustainable Rural Tourism Evaluation Indicators. *International Journal of Tourism Research*, 13(5), 401–415. doi:10.1002/jtr.804
- Parker, M. (2018). The impact of disasters on inflation. *Economics of Disasters and Climate Change*, 2(1), 21–48. doi:10.1007/41885-017-0017-y
- Park, H., & Kim, J. D. (2020). Transition towards green banking: Role of financial regulators and financial institutions. *Asian Journal of Sustainability and Social Responsibility*, 5(1). <https://doi.org/10.1186/s41180-020-00034-3>

Compilation of References

- Pástor, L., & Vorsatz, M. B. (2020). Mutual fund performance and flows during the COVID-19 crisis. *Review of Asset Pricing Studies*, 10(4), 791–833. doi:10.1093/rapstu/raaa015
- Paterson, M. (2020). Climate change and international political economy: Between collapse and transformation. *Review of International Political Economy*, 1–12. doi:10.1080/09692290.2020.1830829
- Paudel, U. R., Parajuli, S., Devkota, N., & Mahapatra, S. K. (2020). What determines customers' perception of banking communication? An empirical evidence from commercial banks of Nepal. *Global Economy Journal*, doi:10.1142/S2194565920500190
- Pellegrino, C., & Lodhia, S. (2012). Climate change accounting and the Australian mining industry: Exploring the links between corporate disclosure and the generation of legitimacy. *Journal of Cleaner Production*, 36, 68–82. doi:10.1016/j.jclepro.2012.02.022
- Pelling, M., & High, C. (2005). Understanding adaptation: What can social capital offer assessments of adaptive capacity? *Global Environmental Change*, 15(4), 308–319. doi:10.1016/j.gloenvcha.2005.02.001
- Peng, Y., & Lin, S. (2008). Local Responsiveness Pressure, Subsidiary Resources, Green Management Adoption, and Subsidiaries' Performance: Evidence from Taiwanese Manufacturers. *Journal of Business Ethics*, 79(1/2), 199–212. doi:10.1007/10551-007-9382-8
- Petersen, H. L. (2013). Coalition of Environmentally Responsible Economies (CERES). In S. O. Idowu, N. Capaldi, L. Zu, & A. Das Gupta (Eds.), *Encyclopedia of Corporate Social Responsibility* (pp. 365–367). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-28036-8_467.
- Phuong, N. (2020). Factors affecting the development of green banks in Vietnam. *Accounting*, 6(6), 991–1000. doi:10.5267/j.ac.2020.7.020
- Pidgeon, N. (2012). Climate change risk perception and communication: Addressing a critical moment. *Risk Analysis: An International Journal*, 32(6), 951–956. doi:10.1111/j.1539-6924.2012.01856.x PMID:22708693
- Pihkala, P. (2018). Eco-Anxiety, Tragedy, and Hope: Psychological and Spiritual Dimensions of Climate Change: with Karl E. Peters: “Living with the Wicked Problem of Climate Change”; Paul H. Carr: “What Is Climate Change Doing to Us and for Us?”; James Clement van Pelt: “Climate Change in Context: Stress, Shock, and the Crucible of Living-kind”; Robert S. Pickart: “Climate Change at High Latitudes: An Illuminating Example”; Emily E. Austin: “Soil Carbon Transformations”; David A. Larrabee: “Climate Change and Conflicting Future..... *Zygon*, 53(2), 545–569. doi:10.1111/zygo.12407
- Pillai, R. (2019). *Perspective and usage patterns of green banking services: A cross-sectional analysis of customers from selected banks in Kerala*. Academic Press.
- Pointner, W., & Ritzberger-Grunwald, D. (2019). Climate change as a risk to financial stability. *Financial Stability Report*, 38, 30–45.
- Pollock, T. G., Whitbred, R. C., & Contractor, N. (2000). Social information processing and job characteristics. A simultaneous test of two theories with implications for job satisfaction. *Human Communication Research*, 26(2), 292–330. doi:10.1093/hcr/26.2.292
- Porgiou, K., & Brotherton, I. (1999). A Management Planning Framework Based on Ecological, Perceptual and Economic Carrying Capacity: The Case Study of Vikos-Aoos National Park, Greece. *Journal of Environmental Management*, 56(4), 271–284. doi:10.1006/jema.1999.0285

- Porter, J. R., Xie, L., Challinor, A. J., Cochrane, K., Howden, M., Iqbal, M. M., Lobell, D. B., & Travasso, M. I. (2014). Food security and food production systems, climate change 2014, Impacts, Adaptation and Vulnerability. Working Group 11 contribution to the IPCC 5th Assessment Report, Geneva, Switzerland
- Porter, M. (1985). *Competitive strategy*. Free Press.
- Porter, M., & van der Linde, C. (1995). Green and competitive: Ending the stalemate. *Harvard Business Review*, 83(5), 120–151.
- Porter, S. D., Reay, D. S., Higgins, P., & Bomberg, E. (2016). A half-century of production-phase greenhouse gas emissions from food loss & waste in the global food supply chain. *The Science of the Total Environment*, 571, 721–729. doi:10.1016/j.scitotenv.2016.07.041 PMID:27432722
- Pradeep, D., & Prabhu, N. (2011). The relationship between effective leadership and employee performance. *Journal of Advancements in Information Technology*, 20, 198–207.
- Praditya, I. (2017). *Pertumbuhan Ekonomi di Indonesia Melambat, Ini Buktinya*. Liputan 6.Com. <https://www.liputan6.com/bisnis/read/4018038/pertumbuhan-ekonomi-indonesia-melambat-ini-buktinya>
- Premier.gov.pl. (2019). *Dokument: System EU ETS po 2020 r. – rekomendacje*. Retrieved from <https://www.gov.pl/web/premier/dokument-system-eu-ets-po-2020-r--rekomendacje>
- Preston, P. (2005). The power image: Strategies for acting and being powerful. *Journal of Healthcare Management*, 50(4), 222–225.
- Price Waterhousecoopers. (2010). *A practical guide to accounting for property under the cost model*. Retrieved from https://www.pwc.com/jp/en/assurance/research-insights-report/assets/pdf/imre_22en.pdf
- PricewaterhouseCoopers (PWC). (2016). *PWC's navigating the SDG's: A business guide to engaging with the UN global goals 2016 on SDG 13 Climate action*. Retrieved from <https://www.pwc.com/mu/en/events/CRA2019/cragoals/Goal13.pdf>
- Procter & Gamble. (n.d.). <http://www.pg.com>
- Proposal for a Council Directive amending Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity, COM(2011)169/3.
- Prudential Regulation Authority. (2019). *Enhancing banks' and insurers' approaches to managing the financial risks from climate change*. Supervisory Statement/SS3/19.
- Puig, D., Olhoff, A., Bee, S., Dickson, B., & Alverson, K. (Eds.). (2016). The adaptation finance gap report. United Nations Environment Programme (UNEP).
- Purvis, B., Mao, Y., & Robinson, D. (2018). The Three Pillars of Sustainability: In Search of Conceptual Origins. *Sustainability Science*, 14(3), 681–695. doi:10.1007/11625-018-0627-5
- PwC. (2016). *Powering Nigeria for the future*. Retrieved from <https://www.pwc.com/gx/en/growth-markets-centre/assets/pdf/powering-nigeria-future.pdf>
- PWC. (2017). *SDG Reporting Challenge 2017: Exploring business communication on the global goals*. <https://www.pwc.com/sdgreportingchallenge>
- Pye, E. K. (2016). *How will climate change the chemical industry?* Retrieved from <https://www.Irsm.upenn.edu/event/how-will-climate-change-change-chemical-industry/>

Compilation of References

- Qian, W., Burritt, R., & Monroe, G. (2011). Environmental management accounting in local government: A case of waste management. *Accounting, Auditing & Accountability Journal*.
- Qiu, L., Jie, X., Wang, Y., & Zhao, M. (2020). Green product innovation, green dynamic capability, and competitive advantage: Evidence from Chinese manufacturing enterprises. *Corporate Social Responsibility and Environmental Management*, 27(1), 146–165. doi:10.1002/csr.1780
- Qiu, Y., Shaukat, A., & Tharyan, R. (2016). Environmental and social disclosures: Link with corporate financial performance. *The British Accounting Review*, 48(1), 102–116. doi:10.1016/j.bar.2014.10.007
- Quatrosi, M. (2017). EU ETS revenues and member states investment strategies. *Economics and Policy of Energy and the Environment*, 2017(3), 41–57. doi:10.3280/EFE2017-003003
- Rafindadi, A. A., & Usman, O. (2019). Globalization, energy use, and environmental degradation in South Africa: Startling empirical evidence from the Maki-cointegration test. *Journal of Environmental Management*, 244, 265–275.
- Ragnhild, B. Fuglestedt, Berntsen, Peters, Andrew, Allen, & Kallbekken. (2017). Perspective has a strong effect on the calculation of historical contributions to global warming. *Environ. Res.*, 12(2).
- Ragupathi, M., & Sujatha, S. (2015). Green banking initiatives of commercial banks in India. *International Research Journal of Business and Management*, 8(2), 74–81.
- Rahman, M. M., Ahsan, M. A., Hossain, M., & Hoq, M. R. (2013). Green Banking Prospects in Bangladesh. *Asian Business Review*, 2(4). doi:10.18034/abr.v2i2.112
- Rahman, M., Rana, R., & Khanam, R. (2020). *Determinants of Life Expectancy in Most Polluted Countries: Exploring the Effect of Environmental Degradation*. Academic Press.
- Rai, R. (2019). *Customers perception on green banking practices in commercial banks of Kathmandu, Nepal* (MBA) Quest International College, Pokhara University.
- Rainforest Action Network. (2019). *Banking on climate change: fossil fuel finance report card*. https://www.ran.org/wp-content/uploads/2019/03/Banking_on_Climate_Change_2019_vFINAL1.pdf
- Raj, D., & Rajan, D. (2017). A Study on the customer awareness on green banking initiatives. *Intercontinental Journal of Finance Research Review*, 5(7), 54–65.
- Rajesh, T., & Dileep, A. (2014). Role of banks in sustainable economic development through green banking. *International Journal of Current Research and Academic Review*, 5(2), 22-34.
- Ramadhan, I. A., & Wirnyansih. (2020). Green sukuk issuance as an investment instrument for sustainable development. *Advances in Social Science, Education and Humanities Research*, 413, 95–98. doi:10.2991/assehr.k.200306.189
- Ramla, D. (2018). *Factors Constraining Entrepreneurs from Starting, Growing and Developing: A South African Context*, Wits University, Johannesburg, South Africa (Unpublished Masters Dissertation).
- Ranjan, R. K. (2020). Green Marketing: An Exploration through Qualitative Research. *Global Journal of Management and Business Research*, 19(8), 27–35.
- Rao, K. (2017). *Climate change and housing: will a rising tide sink all homes?* <https://www.zillow.com/research/climate-changeunderwater-homes-12890/>
- Rashid, L. (2019). Entrepreneurship Education and Sustainable Development Goals: A literature Review and a Closer Look at Fragile States and Technology-Enabled Approaches. *Sustainability*, 11(19), 5343. doi:10.3390/u11195343

- Ratten, V., & Dana, L. P. (2017). Sustainable entrepreneurship, family farms and the dairy industry. *International Journal of Social Ecology and Sustainable Development*, 8(3), 114–129. doi:10.4018/IJSESD.2017070108
- Rayner, R. (2010). *Incorporating climate change within asset management*. Retrieved from <https://www.lse.ac.uk/newsletters/CATS/pdfs/Asset%20Management%20-%20Final%20Proof.pdf>
- Regulation (EU) No 691/2011 of the European Parliament and of the Council of 6 July 2011 on European environmental economic accounts, OJ L 192, 22.7.2011, 1–16.
- Reidmiller, D. R., Avery, C. W., Easterling, D. R., Kunkel, K. E., Lewis, K. L. M., Maycock, T. K., & Stewart, B. C. (2018). *Impacts, Risks, and Adaptation in the United States: The Fourth National Climate Assessment* (Vol. 2). U.S. Global Change Research Program.
- Renaudeau, D., Collin, A., Yahav, S., De Basilio, V., Gourdine, J. L., & Collier, R. J. (2012). Adaptation to hot climate and strategies to alleviate heat stress in livestock production. *Animal*, 6(05), 707–728. doi:10.1017/S1751731111002448 PMID:22558920
- Ren, R., Hu, W., Dong, J., Sun, B., Chen, Y., & Chen, Z. (2019). A Systematic Literature Review of Green and Sustainable Logistics: Bibliometric Analysis, Research Trend and Knowledge Taxonomy. *International Journal of Environmental Research and Public Health*, 17(1), 261. doi:10.3390/ijerph17010261 PMID:31905934
- Ren, S., Tang, G., & Jackson, S. E. (2018). Green human resource management research in emergence: A review and future directions. *Asia Pacific Journal of Management*, 35(3), 769–803. doi:10.1007/10490-017-9532-1
- Renwick, D. W., Redman, T., & Maguire, S. (2013). Green human resource management: A review and research agenda. *International Journal of Management Reviews*, 15(1), 1–14. doi:10.1111/j.1468-2370.2011.00328.x
- Republic of Turkey Ministry of Culture and Tourism. (n.d.). *Çevresel Etki Değerlendirmesi*. <http://www.ktbyatirimisletmeler.gov.tr/TR,11593/cevresel-etkidegerlendirmesi-ced.html>
- Research and Markets. (2020). Global waste to energy market (2020 to 2025) – Featuring Hitachi Zosen, SUEZ and Veolia among others. *GlobeNewswire*. Retrieved from <https://www.globenewswire.com/news-release/2020/11/24/2132575/0/en/Global-Waste-to-Energy-Market-2020-to-2025-Featuring-Hitachi-Zosen-SUEZ-and-Veolia-Among-Others.html>
- Reser, J. P., & Bradley, G. L. (2017). Fear appeals in climate change communication. In *Oxford research encyclopedia of climate science*. doi:10.1093/acrefore/9780190228620.013.386
- Reynolds, T. W., Bostrom, A., Read, D., & Morgan, M. G. (2010). Now what do people know about global climate change? Survey studies of educated laypeople. *Risk Analysis: An International Journal*, 30(10), 1520–1538. doi:10.1111/j.1539-6924.2010.01448.x PMID:20649942
- Rhodes, C. J. (2016). The 2015 Paris climate change conference: COP21. *Science Progress*, 99(1), 97–104. doi:10.3184/003685016X14528569315192 PMID:27120818
- Ricart, S., Olcina, J., & Rico, A. M. (2019). Evaluating public attitudes and farmers’ beliefs towards climate change adaptation: Awareness, perception, and populism at European level. *Land (Basel)*, 8(1), 4. doi:10.3390/land8010004
- Ricart, S., Olcina, J., & Rico, A. M. (2019). Evaluating Public Attitudes and Farmers’ Beliefs towards Climate Change Adaptation: Awareness, Perception, and Populism at European Level. *Land (Basel)*, 8, 4.
- Ridoutt, B., Sanguansri, P., Bonney, L., Crimp, S., Lewis, G., & Lim-Camacho, L. (2016). *Climate change adaptation strategy in the food industry—insights from product carbon and water footprints*. Retrieved from <https://webcache.googleusercontent.com/search?q=cache:nFzQ1-AyoYwJ:https://www.mdpi.com/2225-1154/4/2/26/pdf+&cd=1&hl=en&ct=clnk&gl=za>

Compilation of References

- Rieckhof, R., Bergmann, A., & Guenther, E. (2015). Interrelating material flow cost accounting with management control systems to introduce resource efficiency into strategy. *Journal of Cleaner Production*, *108*, 1262–1278.
- Rinkesh. (2021). *17 Top Most Polluted Countries in the World as of 2020*. Available from: <https://www.conserve-energy-future.com/top-most-polluted-countries-world.php>
- Ripple, W., Wolfe, C., Newsome, T., Barnard, P., & Moomwa, W. (2019). World scientists' warning of climate emergency. *Bioscience*, *70*(1), 8–12.
- Risal, N., & Joshi, S. (2018). Measuring green banking practices on bank's environmental performance: Empirical evidence from Kathmandu valley. *Journal of Business and Social Sciences*, *2*(1), 44–56. doi:10.3126/jbss.v2i1.22827
- Robbie, M. K. (1998). Venture capital and private equity: A review and synthesis. *Journal of Business Finance & Accounting*, *25*(5-6), 521–570.
- Rodríguez-Urrego, D., & Rodríguez-Urrego, L. (2020). Air quality during the COVID-19: PM2.5 analysis in the 50 most polluted capital cities in the world. *Environmental Pollution*, *266*, 115042. doi:10.1016/j.envpol.2020.115042 PMID:32650158
- Roelofs, C. (2018). Without warning: Worker deaths from heat 2014–2016. *New Solutions*, *28*(2), 344–357.
- Rogerson, J. M., & Sims, S. R. (2012). *The greening of urban hotels in South Africa: Evidence from Gauteng*. Paper presented at the Urban forum.
- Rojas Blanco, A. V. (2006). Local initiatives and adaptation to climate change. *Disasters*, *30*(1), 140–147. doi:10.1111/j.1467-9523.2006.00311.x PMID:16512866
- Rojas-Downing, M. M., Nejadhashemi, A. P., Harrigan, T., & Woznicki, S. A. (2017). Climate change and livestock: Impacts, adaptation, and mitigation. *Climate Risk Management*, *16*, 145–163. doi:10.1016/j.crm.2017.02.001
- Roncoroni, A., Battiston, S., Escobar Farfán, L. O. L., & Martínez, J. S. (n.d.). *Climate Risk and Financial Stability in the Network of Banks and Investment Funds*. Available online: <https://ssrn.com/abstract=3356459> doi:10.2139/ssrn.3356459
- Roome, N. (2011). Looking back, thinking forward: distinguishing between weak and strong sustainability. In *The Oxford Handbook of Business and the Natural Environment*. Oxford University Press.
- Roscoe, S., Subramanian, N., Jabbour, C. J., & Chong, T. (2019). Green human resource management and the enablers of green organisational culture: Enhancing a firm's environmental performance for sustainable development. *Business Strategy and the Environment*, *28*(5), 737–749. doi:10.1002/bse.2277
- Roy, R. (2018). Evaluating the suitability of community-based adaptation: a case study of Bangladesh. In *Handbook of Climate Change Communication* (Vol. 1, pp. 39–59). Springer. doi:10.1007/978-3-319-69838-0_3
- Rubio-Mozos, E., García-Muiña, F. E., & Fuentes-Moraleda, L. (2019). Rethinking 21st-century businesses: An approach to fourth sector SMEs in their transition to a sustainable model committed to SDGs. *Sustainability (Switzerland)*, *11*(20), 1–23. doi:10.3390/11205569
- Rudebursch, G. D. (2019). Climate change and the federal reserve. FRBSF Economic letter, Federal Reserve Bank of San Francisco.
- Ryghaug, M., Holtan Sørensen, K., & Næss, R. (2011). Making sense of global warming: Norwegians appropriating knowledge of anthropogenic climate change. *Public Understanding of Science (Bristol, England)*, *20*(6), 778–795. doi:10.1177/0963662510362657 PMID:22397085

- Saa, L. (2020, January 27). *PRI welcomes 500th asset owner signatory*. Retrieved from <https://www.unpri.org/pri-blogs/pri-welcomes-500th-asset-owner-signatory/5367.article>
- Saah, P. (2019). *A framework to enhance the sustainability of Small and Medium Size Enterprises in selected municipalities of the North West Province of South Africa* (Doctoral dissertation). North-West University, South Africa.
- Sachs Jeffrey, D., Woo, W. T., Yoshino, N., & Taghizadeh-Hesary, F. (Eds.). (2019). *Handbook of Green Finance: Energy Security and Sustainable Development*. Tokyo: Springer.
- Sadineni, S. B., Madala, S., & Boehm, R. F. (2011). Passive building energy savings: A review of building envelope components. *Renewable & Sustainable Energy Reviews*, *15*(8), 3617–3631. doi:10.1016/j.rser.2011.07.014
- Sadler-Smith, E. (2013). Toward organizational environmental virtuousness. *The Journal of Applied Behavioral Science*, *49*(1), 123–148. doi:10.1177/0021886312471856
- Sadler-Smith, E. (2014). Making sense of global warming: Designing a human resource development response. *European Journal of Training and Development*, *38*(5), 387–397. doi:10.1108/EJTD-07-2013-0076
- Sadler-Smith, E. (2015). Communicating climate change risk and enabling pro-environmental behavioral change through human resource development. *Advances in Developing Human Resources*, *17*(4), 442–459. doi:10.1177/1523422315601087
- Sáez-Martínez, F. J., Díaz-García, C., & González-Moreno, Á. (2016). Factors promoting environmental responsibility in European SMEs: The effect on performance. *Sustainability*, *8*(9), 898. doi:10.3390/s8090898
- Sahoo, P., & Nayak, B. P. (2007). Green banking in India. *The Indian Economic Journal*, *55*(3), 82–98. doi:10.1177/0019466220070306
- Sala, S. (2020). Triple bottom line, sustainability and sustainability assessment, an overview. *Biofuels for a More Sustainable Future*, 47-72.
- Saleh, M. M. A., Jawabreh, O. A., Alsarayreh, M. N., & Malkawi, E. (2018). Environmental accounting as perspective for hotels of Aqaba special economic zone authority (ASEZA). *Problems and Perspectives in Management*, *16*(4), 169–185.
- Salisu, Y., & Abu Bakar, L. J. (2019). Technological capability, relational capability and firms' performance: The role of learning capability. *Revista de Gestão*, *27*(1), 79–99. doi:10.1108/REG-03-2019-0040
- Salman, S. A., Shahid, S., Ismail, T., Ahmed, K., & Wang, X. J. (2018). Selection of climate models for the projection of spatiotemporal changes in temperature of Iraq with uncertainties. *Atmospheric Research*, *213*, 509–522. doi:10.1016/j.atmosres.2018.07.008
- Sam-Aggrey, H., & Lanteigne, M. (2020). *Environmental Security in The Arctic*. Routledge Handbook of Arctic Security. doi:10.4324/9781315265797-9
- Samosir, D. K. B. M., Murwaningsari, E., Augustine, Y., & Mayangsari, S. (2020). The benefit of green building for cost efficiency. *International Journal of Financial, Accounting, and Management*, *1*(4), 209–219.
- Sanders, M. (2019). *The Disadvantages of Tariffs & Quotas*. Available at: <https://smallbusiness.chron.com/disadvantages-tariffs-quotas-20726.html>
- Sandler, R. (2005). Introduction: Environmental virtue ethics. In R. Sandler & P. Cafaro (Eds.), *Environmental virtue ethics* (pp. 1–12). Rowman & Littlefield.
- Sands, J., Lee, K. H., Schaltegger, S., & Zvezdov, D. (2015). Gatekeepers of sustainability information: exploring the roles of accountants. *Journal of Accounting & Organizational Change*.

Compilation of References

- Sands, J., Lee, K.-H., & Gunarathne, N. (2015). Environmental Management Accounting (EMA) for environmental management and organizational change. *Journal of Accounting & Organizational Change*.
- Sarango-Lalangui, P., Santos, J. L. S., & Hormiga, E. (2018). The development of sustainable entrepreneurship research field. *Sustainability*, 10(6), 2005. doi:10.3390/s10062005
- Sarkis, S. (2017). *The 25th anniversary of hurricane Andrew*. National Oceanic and Atmospheric Administration. https://www.aoml.noaa.gov/keynotes/keynotes_0817_andrew25.html
- Sarpong, P. (2020). *Portfolio Management for Financial Advisors*. Centre for Financial Planning Studies.
- Sathye, M. (1999). Adoption of Internet banking by Australian consumers: An empirical investigation. *International Journal of Bank Marketing*, 17(7), 324–334. doi:10.1108/02652329910305689
- Savage, D., & Jasch, C. (2005). *International guidance document on environmental management accounting*. IFAC.
- Saxena, R., & Khandelwal, P. K. (2010). *Sustainable development through green marketing: The industry perspective 2010*. Academic Press.
- Sayne, A. (2011). *Climate change, adaptation and conflict in Nigeria*. United States' Institute of Peace (Special Report 274). www.usip.org
- SC & World Bank. (2019). *Islamic green finance development, ecosystem and prospects*. Kuala Lumpur: Securities Commission (SC) Malaysia.
- Scannell, L., & Gifford, R. (2013). Personally relevant climate change: The role of place attachment and local versus global message framing in engagement. *Environment and Behavior*, 45(1), 60–85. doi:10.1177/0013916511421196
- Schadewitz, H., & Niskala, M. (2010). Communication via responsibility reporting and its effect on firm value in Finland. *Corporate Social Responsibility and Environmental Management*, 17(2), 96–106. doi:10.1002/csr.234
- Schaltegger, S., Bennett, M., Burritt, R. L., & Jasch, C. (2008). *Environmental management accounting for cleaner production*. Academic Press.
- Schaltegger, S., & Synnestvedt, T. (2002). The link between 'green' and economic success: Environmental management as the crucial trigger between environmental and economic performance. *Journal of Environmental Management*, 65(4), 339–346. PMID:12369398
- Schaltegger, S., & Zvezdov, D. (2015). Expanding material flow cost accounting. Framework, review and potentials. *Journal of Cleaner Production*, 108, 1333–1341.
- Schmidt, C. W. (2009). Beyond mitigation: Planning for climate change adaptation. *Environmental Health Perspectives*, 117(7), 306–309.
- Schmidt, M. (2010). Approaches towards the Efficient Use of Resources in the Industry. *Chemical Engineering & Technology: Industrial Chemistry-Plant Equipment-Process Engineering-Biotechnology*, 33(4), 552–558.
- Schmidt, M. (2015). The interpretation and extension of Material Flow Cost Accounting (MFCA) in the context of environmental material flow analysis. *Journal of Cleaner Production*, 108, 1310–1319.
- Schneider, S., & Surukhan, J. (2020). *Overview of Impacts, Adaptation and Vulnerability to Climate Change*. Academic Press.

- Scholz, P. (2016a). *Ekonomické aspekty uplatňování environmentálního managementu na příkladu hotelů třídy luxury v české republice economic aspects of implementation of environmental management on an example of luxury class hotels*. Paper presented at the Hradecké ekonomické dny 2015, Milano, Italy.
- Scholz, P. (2016b). *Green Management Implementation in Accommodation Facilities in Slovakia*. Academic Press.
- Schub, J. (2015). Green Banks: Growing clean energy markets by leveraging private investment with public financing. *The Journal of Structured Finance*, 21(3), 26–35. doi:10.3905/jsf.2015.21.3.026
- Schulte, P. A., Bhattacharya, A., Butler, C. R., Chun, H. K., Jacklitsch, B., Jacobs, T., & Wagner, G. R. (2016). Advancing the framework for considering the effects of climate change on worker safety and health. *Journal of Occupational and Environmental Hygiene*, 13, 847–865.
- Schulze, R. E. (2005). Adapting to climate change in the water resources sector in South Africa. In R. E. Schulze (Ed.), *Climate change and water resources in southern Africa: Studies on scenarios, impacts, vulnerabilities, and adaptation*. WRC Report 1430/1/05.
- Scott, M., van Huizen, J. & Jung, C. (2017). The Bank of England's response to climate change. *Bank of England Quarterly Bulletin*, 98-109.
- Scott, D., Hall, C. M., & Gössling, S. (2016). A report on the Paris Climate Change Agreement and its implications for tourism: Why we will always have Paris. *Journal of Sustainable Tourism*, 24(7), 933–948. doi:10.1080/09669582.2016.1187623
- Scully-Russ, E. (2012). Human resource development and sustainability: Beyond sustainable organizations. *Human Resource Development International*, 15(4), 399–415. doi:10.1080/13678868.2012.707529
- Scully-Russ, E. (2015). The contours of green human resource development. *Advances in Developing Human Resources*, 17(4), 411–425. doi:10.1177/1523422315600839
- Seabright, M. A. (2010). The role of the affect heuristic in moral reactions to climate change. *Journal of Global Ethics*, 6(1), 5–15. doi:10.1080/17449621003701410
- Seacrest, S., Kuzelka, R., & Leonard, R. (2000). Global climate change and public perception: The challenge of translation. *Journal of the American Water Resources Association*, 36(2), 254. doi:10.1111/j.1752-1688.2000.tb04265.x
- Secinaro, S., Brescia, V., Calandra, D., & Saiti, B. (2020). Impact of climate change mitigation policies on corporate financial performance: Evidence-based on european publicly listed firms. *Corporate Social Responsibility and Environmental Management*, 27(6), 2491–2501. doi:10.1002/csr.1971
- Sehgal, R. N. M. (2010). Deforestation and avian infectious diseases. *The Journal of Experimental Biology*, 213(6), 955–960. doi:10.1242/jeb.037663 PMID:20190120
- Self, P. (2021). *Government by the Market? The Politics of Public Choice*. Routledge. doi:10.4324/9780429039393
- Semtrio. (n.d.). *Ekolojik Ayak İzi Nedir?* <https://www.semtrio.com/ekolojik-ayak-izi>
- Senge, P. M. (1997). The fifth discipline. *Measuring Business Excellence*, 1(3), 46–51. doi:10.1108/eb025496
- Senge, P. M., Carstedt, G., & Porter, P. L. (2001). Next industrial revolution. *MIT Sloan Management Review*, 42(2), 24–38.
- Seto-Pamies, D. & Papaoikonomou, E. (2020). *Sustainable development goals: A powerful framework for embedding ethics, CSR, and sustainability in management education*. Academic Press.

Compilation of References

- Sevillano, J., & Gonzalez, L. (2019). The risk of climate change for financial markets and institutions: challenges, measures adopted and international initiatives. *Banco de España*.
- Shafaei, A., Nejati, M., & Yusoff, Y. M. (2020). Green human resource management: A two-study investigation of antecedents and outcomes. *International Journal of Manpower*, *41*(7), 1041–1060. doi:10.1108/IJM-08-2019-0406
- Shafiq, A., Klassen, R. D., Johnson, F., & Awaysheh, A. (2014). Socially responsible practices: An exploratory study on scale development using stakeholder theory. *Decision Sciences*, *45*(4), 683–716. doi:10.1111/deci.12085
- Shahbazi, S., Wiktorsson, M., Kurdve, M., Jönsson, C., & Bjelkemyr, M. (2016). Material efficiency in manufacturing: Swedish evidence on potential, barriers and strategies. *Journal of Cleaner Production*, *127*(Supplement C), 438–450.
- Shakil, M. H., Azam, M., & Raju, M. (2014). An evaluation of green banking practices in Bangladesh. *European Journal of Business and Management*, *6*(31), 8–16.
- Shamim, S., Cang, S., Yu, H., & Li, Y. (2016, July). Management approaches for Industry 4.0: A human resource management perspective. In *2016 IEEE Congress on Evolutionary Computation (CEC)* (pp. 5309-5316). IEEE. 10.1109/CEC.2016.7748365
- Shampa, T., & Jobaid, M. (2017). Factors influencing customers' expectation towards green banking practices in Bangladesh. *European Journal of Business and Management*, *9*(12), 140–152.
- Shang, J., Basil, D. Z., & Wymer, W. (2010). Using social marketing to enhance hotel reuse programs. *Journal of Business Research*, *63*(2), 166–172.
- Sharma, N., Sarika, K., & Gopal, R. (2014). A study on customer's awareness on Green Banking initiatives in selected public and private sector banks with special reference to Mumbai. *IOSR Journal of Economics and Finance*, *2*, 28–35.
- Shaumya, K., & Arulrajah, A. (2017 August). Green banking practices of selected private sector banks in Sri Lanka. In *Proceedings of the Third Jaffna University International Research Conference*. University of Jaffna.
- Shaumya, K., & Arulrajah, A. (2017). The Impact of Green Banking Practices on Bank's Environmental Performance: Evidence from Sri Lanka. *Journal of Finance and Bank Management*, *5*(1), 77–90.
- Sheldon, T. L., & Zhan, C. (2019). The impact of natural disasters on us homeownership. *Journal of the Association of Environmental and Resource Economists*, *6*(6), 1169–1203. doi:10.1086/705398
- Shen, J., & Zhang, H. (2019). Socially responsible human resource management and employee support for external CSR: Roles of organizational CSR climate and perceived CSR directed toward employees. *Journal of Business Ethics*, *156*(3), 875–888. doi:10.1007/10551-017-3544-0
- Sheopuri, A., & Sheopuri, A. (2015). Green HR practices in the changing workplace. *Business Dimensions*, *2*(1), 13–26.
- Shi, L., Han, L., Yang, F., & Gao, L. (2019). The Evolution of Sustainable Development Theory: Types, Goals, and Research Prospects. *Sustainability*, *11*(24), 1–16. doi:10.3390/11247158
- Shi, Y., Magnan, M., & Kim, J. B. (2012). Do countries matter for voluntary disclosure? Evidence from cross-listed firms in the US. *Journal of International Business Studies*, *43*(2), 143–165. doi:10.1057/jibs.2011.38
- Shrestha, S., Devkota, N., Paudel, U., Bhandari, U., & Parajuli, S. (2020). Bankers' Communication Know-how: An Analysis from Commercial Banks of Kathmandu valley. *Quest Journal of Management and Social Sciences*, *2*(1), 80–99.
- Shrivastava, P. (1995). The role of corporations in achieving ecological sustainability. *Academy of Management Review*, *20*(4), 936–960. doi:10.5465/amr.1995.9512280026

- Shu, C., Zhao, M., Liu, J., & Lindsay, W. (2020). Why firms go green and how green impacts financial and innovation performance differently: An awareness-motivation-capability perspective. *Asia Pacific Journal of Management*, 37(3), 795–821. doi:10.1007/10490-018-9630-8
- Sief, H. S. (2014). Accounting Framework to Measure the Environmental Costs and Disclosed in Industrials Companies- Case Study of Societe Cement Hamma Bouziane (SCHB) in Constantine. *The China Business Review*, 13(6), 356–366.
- Simmers, C. A., McMurray, A., Stoughton, A. M., & Curi, D. P. (2020). *Enacting corporate humanistic management through sustainable development innovation*. Humanistic Values from Academic Community Perspective.
- Singh, H., & Sharma, A. (2020). Green Marketing: A Conceptual Study on Initiatives and Start-ups Taken by Industries for Making Green India. *Studies in Indian Place Names*, 40(56), 1086–1092.
- Singh, N., Cranage, D., & Lee, S. (2014). Green strategies for hotels: Estimation of recycling benefits. *International Journal of Hospitality Management*, 43, 13–22.
- Singh, S., Hanna, E. G., & Kjellstrom, T. (2013). Working in Australia's heat: Health promotion concerns for health and productivity. *Health Promotion International*, 30, 239–250.
- Singjai, K., Winata, L., & Kummer, T.-F. (2018). Green initiatives and their competitive advantage for the hotel industry in developing countries. *International Journal of Hospitality Management*, 75, 131–143.
- Slack, N., Chambers, S., & Johnston, R. (2003). *Operations management* (4th ed.). FT Prentice Hall.
- Slaper, T., & Hall, T. (2011). The Triple Bottom Line: What Is It and How Does it Work? *Indiana Business Review*, 1-7.
- Slater, R., Peskett, L., Ludi, E., & Brown, D. (2007). Climate change, agricultural policy and poverty reduction-how much do we know? *Natural Resource Perspectives*, 19.
- Slave, C., & Man, C. (2012). The contribution of human activities to climate change. In *Agrarian Economy and Rural Development-Realities and Perspectives for Romania, 3rd Edition of the International Symposium*. The Research Institute for Agricultural Economy and Rural Development (ICEADR).
- Slobodan & Peter. (2012). Green Banking -Green Financial Products with Special Emphasis on Retail Banking Products. In *2nd Climate Change, Economic Development, Environmental and People Conference (CCEDEP)*. Sremska Kamenica: Educons University.
- Solikhah, B., Yulianto, A., & Suryarini, T. (2020). March. Legitimacy Theory Perspective on the Quality of Carbon Emission Disclosure: Case Study on Manufacturing Companies in Indonesia Stock Exchange. *IOP Conference Series: Earth and Environmental Science*, 1(1), 12-63.
- Sonuç, N. (2014). *Sürdürülebilir Turizm: Tanımı ve İçeriği*. In *Metin Kozak*. Detay Publishing.
- Soto-Acosta, P., Del Giudice, M., & Scuotto, V. (2018). Emerging issues on business innovation ecosystems: The role of information and communication technologies (ICTs) for knowledge management (KM) and innovation within and among enterprises. *Baltic Journal of Management*, 13(3), 298–302. doi:10.1108/BJM-07-2018-398
- Sousa, P., Gomes, D., & Formigo, N. (2020). Ecosystem Services in Environmental Impact Assessment. *Energy Reports*, 6(1), 466–471. doi:10.1016/j.egy.2019.09.009
- Soyka, P. A. (2012). *Creating a sustainable organization: Approaches for enhancing corporate value through sustainability*. FT Press.
- Spence, A., Poortinga, W., & Pidgeon, N. (2012). The psychological distance of climate change. *Risk Analysis: An International Journal*, 32(6), 957–972. doi:10.1111/j.1539-6924.2011.01695.x PMID:21992607

Compilation of References

- Spreitzer, G. M., & Sonenshein, S. (2004). Toward the construct definition of positive deviance. *The American Behavioral Scientist*, 47(6), 828–847. doi:10.1177/0002764203260212
- Srinivas, H. (2020). *The Coalition for Environmentally Responsible Economies (CERES) Principles*. Sustainable and Green Businesses: Documents and Reports. <https://www.gdrc.org/sustbiz/ceres-principles.html>
- Sriyana, J. (2009). *Peranan sukuk negara terhadap peningkatan fiscal sustainability*. A paper was presented at Symposium Nasional IV Sistem Ekonomi Islam 2009 ‘Strengthening Institutions on Islamic Economic’ at Universitas Islam Indonesia (UII) Yogyakarta, Yogyakarta.
- SSE. (2019). *Nigerian Stock Exchange*. Sustainable Stock Exchanges Initiative. https://sseinitiative.org/stock-exchange/nse_nigeria/
- Stabler, M., & Goodall, B. (1997). Environmental awareness, action and performance in the Guernsey hospital sector. *Tourism Management*, 18(1), 19–33. doi:10.1016/S0261-5177(96)00095-7
- Stahl, G. K., Brewster, C. J., Collings, D. G., & Hajro, A. (2020). Enhancing the role of human resource management in corporate sustainability and social responsibility: A multi-stakeholder, multidimensional approach to HRM. *Human Resource Management Review*, 30(3), 100708. doi:10.1016/j.hrmr.2019.100708
- Stanton, T. (2017). *Enterprise risk management*. Youtube TEDxJHUUC.
- State and Territorial Air Pollution Program Administrators (STAPPA) & Association of Local Air Pollution Control Officials (ALAPCO). (1999). *Reducing greenhouse gases and air pollution: a menu of harmonized options*. Retrieved from <https://www.oecd.org/environment/cc/2055676.pdf>
- Steffen, W., Rockstrom, J., Richardson, K., Lenton, T., Folke, C., Liverman, D., Summerhayes, C. P., Barnosky, A. D., Cornell, S. E., Crucifix, M., Donges, J. F., Fetzer, I., Lade, S. J., Scheffer, M., Winkelmann, R., & Schellnhuber, H. J. (2018). Trajectories of the earth system in the Anthropocene. *Proceedings of the National Academy of Sciences of the United States of America*, 115(33), 8252–8259. doi:10.1073/pnas.1810141115 PMID:30082409
- Steg, L. (2018). Limiting climate change requires research on climate action. *Nature Climate Change*, 8(9), 759–761. doi:10.1038/41558-018-0269-8
- Stern, N. (2014). *The economics of climate change*. Cambridge University Press.
- Stern, P. C., Dietz, T., & Kalof, L. (1993). Value orientations, gender, and environmental concern. *Environment and Behavior*, 25(5), 322–348. doi:10.1177/0013916593255002
- Stolbova, V., Monasterolo, I., & Battiston, S. (2018). A financial macro-network approach to climate policy evaluation. *Ecological Economics*, 149, 239–253. doi:10.1016/j.ecolecon.2018.03.013
- Streletskiy, D. A., Suter, L. J., Shiklomanov, N., Porfiriev, B. N. & Eliseev, D. O. (2019). Assessment of climate change impacts on buildings, structures and infrastructure in the Russian regions on permafrost. *Environmental Research Letters*, 14, 13. doi:10.1088/1748-9326/aaf5e6
- Styles, D., Schoenberger, H., & Galvez-Martos, J. L. (2015). Water management in the European hospitality sector: Best practice, performance benchmarks and improvement potential. *Tourism Management*, 46, 187–202.
- Suarez, P., Linnerooth-Bayer, J., & Mechler, R. (2007). *The Feasibility of Risk Financing Schemes for Climate Adaptation: The case of Malawi*. DEC-Research Group, Infrastructure and Environment Unit. The World Bank.
- Subramanian, V., Semenzin, E., Hristosov, D., Marcomini, A., & Linkov, I. (2014). Sustainable nanotechnology: Defining, Measuring and Teaching. *Nano Today*, 9(1), 6–9. doi:10.1016/j.nantod.2014.01.001

- Sucheran, R. (2013). *Environmental management in the hotel and lodge sector in KwaZulu-Natal*.
- Suchman, M. C. (1995). Managing legitimacy: Strategic and institutional approaches. *Academy of Management Review*, 20(3), 571–610. doi:10.5465/amr.1995.9508080331
- Sudin, S. (2011, June). Strategic green HRM: A proposed model that supports corporate environmental citizenship. In *International Conference on Sociality and Economics Development, IPEDR* (pp. 79-83). Prentice Hall.
- Sun, Q., Miao, C., Hanel, M., Borthwick, A. G., Duan, Q., Ji, D., & Li, H. (2019). Global heat stress on health, wildfires, and agricultural crops under different levels of climate warming. *Environment International*, 128, 125–136. doi:10.1016/j.envint.2019.04.025 PMID:31048130
- Sun, Y. (2020). *The impacts of climate change risk on financial performance of mining industry: Evidence from listed companies in China*. Hubei University of Economics. 10. doi:10.1016/j.resourpol.202.101828
- Swanson, R. A. (1998). Demonstrating the financial benefit of human resource development: Status and update on the theory and practice. *Human Resource Development Quarterly*, 9(3), 285–295. doi:10.1002/hrdq.3920090307
- Swart, R., Robinson, J., & Cohen, S. (2003). Climate change and sustainable development: expanding the options. *Climate Policy*, 3(sup1), S19-S40.
- Szennay, Á., Szigeti, C., Kovács, N., & Szabó, D. R. (2019). Through the Blurry Looking Glass— SDGs in the GRI Reports. *Resources*, 8(101), 1–17. <https://doi.org/10.3390/resources8020101>
- Tabari, H. (2020). Climate change impact on flood and extreme precipitation increases with water availability. *Scientific Reports*, 10(1), 13768. doi:10.103841598-020-70816-2 PMID:32792563
- Tajelawi, O. A. (2016). *Using Material Flow Cost Accounting to determine the impacts of packaging waste costs in alcoholic beverage production in an alcoholic beverage company in Durban*. Department of Management Accounting, Faculty of Accounting and Informatics, Durban University of Technology.
- Takouleu, J. M. (2021). *AFRICA: Grino to work with Africa GreenTec for solar water treatment*. Afrik21. <https://www.afrik21.africa/en/africa-grino-to-work-with-africa-greentec-for-solar-water-treatment/>
- Taleb, N. N. (2007). *The black swan: The impact of the highly improbable* (Vol. 2). Random house.
- Tamura, K., & Yu, Y. (2015). Cycles for strengthening mitigation and support. In *The Paris climate agreement and beyond: Linking short-term climate actions to long-term goals* (pp. 33–58). IGES.
- Tandukar, H. (2019). *Customers perception on green banking practices in commercial banks of Kathamndu, Nepal* (MBA). Quest International College, Pokhara University.
- Tang, G., Chen, Y., Jiang, Y., Paille, P., & Jia, J. (2018). Green human resource management practices: Scale development and validity. *Asia Pacific Journal of Human Resources*, 56(1), 31–55. doi:10.1111/1744-7941.12147
- Tariq, S., Jan, F. A., & Ahmad, M. S. (2016). Green employee empowerment: A systematic literature review on state-of-art in green human resource management. *Quality & Quantity*, 50(1), 237–269. doi:10.1007/11135-014-0146-0
- Task Force on Climate-Related Financial Disclosures. (2017). *Final report: Recommendations of the Task Force on Climate-related Financial Disclosures*. Retrieved 12/01/2021, from <https://assets.bbhub.io/company/sites/60/2020/10/FINAL-2017-TCFD-Report-11052018.pdf>
- Task Force on Climate-related Financial Disclosures. (2021). *Task Force on Climate-related Financial Disclosures*. TCFD. <https://www.fsb-tcfd.org/>

Compilation of References

- TCFD. (2017). *Final report: recommendations of the task force on climate-related financial disclosures*. Financial Stability Board Task Force on Climate-related Financial Disclosures. Available at: www.fsb-tcf.org/wp-content/uploads/2017/06/FINAL-TCFD-Report-062817.pdf
- TCFD. (2019). *The Use of Scenario Analysis in Disclosure of Climate-related Risk and Opportunities. A technical supplement of Climate Disclosure Standard Board*. Retrieved on 19/01/2021. www.tcfhub.org
- Teicher, H. M. (2018). Practices and pitfalls of competitive resilience: Urban adaptation as real estate firms turn climate risk to competitive advantage. *Urban Climate*, 25, 9–21. doi:10.1016/j.uclim.2018.04.008
- Teixeira, A. A., Jabbour, C. J. C., de Sousa Jabbour, A. B. L., Latan, H., & De Oliveira, J. H. C. (2016). Green training and green supply chain management: Evidence from Brazilian firms. *Journal of Cleaner Production*, 116, 170–176. doi:10.1016/j.jclepro.2015.12.061
- Tekayak, D. (2014). An Overview of Environmental Impact Assessment in Turkey: Issues and Recommendations. *Ankara Review of European Studies*, 13(2), 133–151.
- Teng, Y.-M. (2011). Applying the extended theory of planned behavior to predict the intention of visiting a green hotel. *African Journal of Business Management*, 5(17), 7579–7587.
- Teoh, H. Y., Pin, F. W., Joo, T. T., & Ling, Y. Y. (1998). Environmental disclosures-financial performance link: Further evidence from industrialising economy perspective. In *APIRA 98 Conference, Paper (No. 40)*. Academic Press.
- Terziev, V. (2016). Entrepreneurship in organic production—an incentive for sustainable rural development. *Agricultural and Resource Economics: International Scientific E-Journal*, 2(4).
- Thaker, J., Smith, N., & Leiserowitz, A. (2020). Global Warming Risk Perceptions in India. *Journal of Risk Analysis*, 40(12), 2481-2497.
- Thampy, A. (2010). Financing of SME firms in India: Interview with Ranjana Kumar, former CMD, Indian bank; vigilance commissioner, central vigilance commission. *IIMB Management Review*, 22(3), 93–101. doi:10.1016/j.iimb.2010.04.011
- The Economist. (2019, May 4). Global meat-eating is on the rise, bringing surprising benefits. *The Economist*.
- The Equator Principles. (2020). www.equator-principles.com
- The Global Warming Policy Foundation. (2020). *The Global Warming Policy Foundation*. Retrieved from: <https://www.thegwpcf.org/>
- The Jakarta Post. (2019). Investree, Java Mountain Coffee continues a “green financing” partnership. *The Jakarta Post*. <https://www.thejakartapost.com/travel/2019/09/23/investree-java-mountain-coffee-continue-green-financing-partnership.html>
- Themelis, N. J. (2003). An overview of the global waste-to-energy industry. *Waste Management World*, (July-August), 40–47.
- Thistlethwaite, J. (2015). The politics of experimentation in climate change risk reporting: The emergence of the Climate Disclosure Standards Board (CDSB). *Environmental Politics*, 24(6), 970–990. doi:10.1080/09644016.2015.1051325
- Thomas, K., Hardy, R. D., Lazrus, H., Mendez, M., Orlove, B., Rivera-Collazo, I., Roberts, J. T., Rockman, M., Warner, B. P., & Winthrop, R. (2019). Explaining differential vulnerability to climate change: A social science review. *Wiley Interdisciplinary Reviews: Climate Change*, 10(2), e565. doi:10.1002/wcc.565 PMID:31007726
- Thombre, K. A. (2011). The new face of banking: Green banking. *Indian Streams Research Journal*, 1(2), 1–4.

- Thornton, P. K., & Herrero, M. (2010). *The Inter-linkages between rapid growth in livestock production, climate change, and the impacts on water resources, land use, and deforestation*. World Bank Policy Research Working Paper, WPS 5178. World Bank.
- Thornton, P. K., Herrero, M., Freeman, A., Mwai, O., Rege, E., Jones, P., & McDermott, J. (2008). *Vulnerability, climate change and livestock: Research opportunities and challenges for poverty alleviation*. International Livestock Research Institute. ILRI.
- Thornton, P. K., Van de Steeg, J., Notenbaert, A., & Herrero, M. (2009). The impacts of climate change on livestock and livestock systems in developing countries: A review of what we know and what we need to know. *Agricultural Systems*, 101(3), 113–127. doi:10.1016/j.agsy.2009.05.002
- Thurik, R., & Wennekers, S. (2004). Entrepreneurship, small business, and economic growth. *Journal of Small Business and Enterprise Development*, 11(1), 140–149. doi:10.1108/14626000410519173
- Timur, S., & Getz, D. (2009). Sustainable Tourism Development: How Do Destination Stakeholders Perceive Sustainable Urban Tourism? *Sustainable Development*, 17(4), 220–232. doi:10.1002/d.384
- Tirado, D., Nilsson, W., Deya-Tortella, B., & Garcia, C. (2019). Implementation of water-saving measures in hotels in Mallorca. *Sustainability*, 11(23), 6880.
- Tiwari, S., Tripathi, D. M., Srivastava, U., & Yadav, P. K. (2011). Green Marketing -Emerging dimension. *Journal of Business Excellence.*, 2(1), PP-18–PP-23.
- TollmanP.ReevesM.WallensteinJ.CookP.BerrimanC. (2020). Available at: <https://www.bcg.com/publications/2020/reflections-on-leadership-during-crisis>
- Tol, R. S. (2018). The economic impacts of climate change. *Review of Environmental Economics and Policy*, 12(1), 4–25. doi:10.1093/reep/rex027
- Tooze, A. (2019). *Why central banks need to step up on global warming*. <https://foreignpolicy.com/2019/07/20/why-central-banks-need-to-step-up-on-global-warming/>
- Touma, D., Stevenson, S., Lehner, F., & Coats, S. (2021). Human-driven greenhouse gas and aerosol emissions cause distinct regional impacts on extreme fire weather. *Nature Communications*, 12(1), 1–8. doi:10.103841467-020-20570-w PMID:33431844
- Tran, B. (2009). Green Management: The reality of Being Green in Business. *Journal of Economics, Finance and Administrative Science*, 14(27), 21–45.
- Tran, T. T., & Herzig, C. (2020). Material flow cost accounting in developing countries: A systematic review. *Sustainability*, 12(13), 5413.
- Trehan, R. (2015). Green banking in India. *Journal of Poverty. Investment and Development*, 14, 27–32.
- Trinks, A., Scholtens, B., Mulder, M., & Dam, L. (2018). Fossil fuel divestment and portfolio performance. *Ecological Economics*, 146, 740–748. doi:10.1016/j.ecolecon.2017.11.036
- Tsai, W.-H., Shen, Y.-S., Lee, P.-L., Chen, H.-C., Kuo, L., & Huang, C.-C. (2012). Integrating information about the cost of carbon through activity-based costing. *Journal of Cleaner Production*, 36, 102–111.
- Tsalis, T. A., Malamateniou, K. E., Koulouriotis, D., & Nikolaou, I. E. (2020). New challenges for corporate sustainability reporting: United Nations' 2030 Agenda for sustainable development and the sustainable development goals. *Corporate Social Responsibility and Environmental Management*, 27(4), 1617–1629. doi:10.1002/csr.1910

Compilation of References

- Tuan, L. A. (2016). *Waste-to-energy plants—public private partnership Singapore*. Retrieved from https://d2oc0ihd6a5bt.cloudfront.net/wpcontent/uploads/sites/837/2016/03/B4_2_TUAN-Loh-Ah_Keppel-Seghers-Engineering-Singapore.pdf
- Turan, E., & Güner, E. (2017). Changes in the Legislation of Environmental Impact Assessment in Turkey. *Journal of Natural Hazards and Environment*, 3(1), 39–47. doi:10.21324/dacd.28618
- Tüsiad. (2012). *Sustainable Tourism*. <https://tusiad.org/tr/yayinlar/raporlar/item/6030-surdurulebilir-turizm>
- Twerefou, D. K., Chinowsky, P., Adjei-Mantey, K., & Strzepek, N. L. (2015). The economic impact of climate change on road infrastructure in Ghana. *Sustainability*, 7(9), 11949–11966. doi:10.3390u70911949
- Uddin, M., & Ahmmed, M. (2018). Islamic banking and green banking for sustainable development: Evidence from Bangladesh. *Al-Iqtishad Journal of Islamic Economics*, 10(1), 97–114. doi:10.15408/aiq.v10i1.4563
- Ukoima, K. N., & Ekwe, O. A. (2019). Review of the impact of electricity supply on economic growth: A Nigerian case study. *Journal of Electrical and Electronics Engineering (Oradea)*, 14(1), 28–34.
- ULI-Heitman. (2019). *Climate Risk and Real Estate Investment Decision-Making: New Report from ULI and Heitman*. Available from: www.heitman.com/news/climate-risk-and-real-estate-investment-decision-making/
- Ullah, W., Nihei, T., Nafees, M., Zaman, R., & Ali, M. (2017). Understanding climate change vulnerability, adaptation and risk perceptions at household level in Khyber Pakhtunkhwa, Pakistan. *International Journal of Climate Change Strategies and Management*, 10, 11.
- Ulrich, D. (1997). Measuring human resources: an overview of practice and a prescription for results. Human Resource Management: Published in Cooperation with the School of Business Administration. *The University of Michigan and in alliance with the Society of Human Resources Management*, 36(3), 303-320.
- Ulubeyli, S., & Kazanci, O. (2018). Holistic sustainability assessment of green building industry in Turkey. *Journal of Cleaner Production*, 202, 197–212. doi:10.1016/j.jclepro.2018.08.111
- Ulupui, I., Murdayanti, Y., Marini, A., Purwohedi, U., Mardia, M., & Yanto, H. (2020). Green accounting, material flow cost accounting and environmental performance. *Accounting*, 6(5), 743–752.
- UN ESCAP. (2014). Sustainable development financing: Perspectives from Asia and the Pacific. A paper prepared by the United Nations (UN) The Economic and Social Commission for Asia and the Pacific (ESCAP) Secretariat for the Regional Outreach of the Intergovernmental Committee of Experts on Sustainable Development Financing for the Asia-Pacific Region, June 10th-11th, Jakarta.
- UN Office for the Coordination of Humanitarian Affairs (OCHA). (2021). *Southern Africa – Tropical Cyclone Eloise Flash Update No.9, As of 26 January 2021*. Reliefweb. <https://reliefweb.int/report/mozambique/southern-africa-tropical-cyclone-eloise-flash-update-no9-26-january-2021>
- UNEP (United Nations Environment Programme). (2012). *Global environment outlook 5: Chapter 5*. https://www.unep.org/geo/pdfs/geo5/GEO5_report_C5.pdf
- UNEP Finance Initiative. (2007). *Green Financial Products and Services Current Trends and Future Opportunities in North America*. A report of the North American Task Force (NATF) of the United Nations Environment Programme Finance Initiative. https://www.unepfi.org/fileadmin/documents/greenprods_01.pdf
- UNEP Finance Initiative. (2017). *The Principles for Positive Impact Finance*. <https://www.unepfi.org/wordpress/wp-content/uploads/2017/01/POSITIVE-IMPACT-PRINCIPLES-AW-WEB.pdf>

- UNEP Finance Initiative. (2019a). *Principles for Responsible Banking*. <https://www.unepfi.org/wordpress/wp-content/uploads/2019/07/FINAL-PRB-Signature-Documents-2-Interactive-22-07-19.pdf>
- UNEP Finance Initiative. (2019b). *The Principles for Responsible Banking*. <https://www.unepfi.org/wordpress/wp-content/uploads/2019/09/Principles-Horizontal.png>
- UNEP Finance Initiative. (2020a). *Africa & Middle East Members*. <https://www.unepfi.org/members/africa-middle-east/>
- UNEP Finance Initiative. (2020b). *Signatories to the Principles for Responsible Banking*. https://www.unepfi.org/wordpress/wp-content/uploads/2021/02/PRB_Signatories_0802-2.pdf
- UNFCCC. (2001). *Funding under the Kyoto Protocol. Decision 10/CP.7, FCCC/CP/2001/13/Add.1*. United Nations Framework Convention on Climate Change.
- UNFCCC. (2007). *Bali Action Plan*. unfccc.int/meetings/cop_13/items/4049.php
- UNFCCC. (2013). *Gaps in existing institutional arrangements within and outside of the Convention to address loss and damage, including those related to slow onset events*. Technical Paper United Nations Framework Convention on Climate Change (UNFCCC) FCCC/TP/2013/12. Retrieved from <https://unfccc.int/resource/docs/2013/tp/12.pdf>
- UNGC & UNEP-FI. (2016). *Principles for responsible investment*. Retrieved from https://www.sedccapital.com/sites/default/files/downloads/pri_brochure_2016_0.pdf
- Ung, M., Luginaah, I., Chuenpagdee, R., & Campbell, G. (2016). Perceived self-efficacy and adaptation to climate change in coastal Cambodia. *Climate (Basel)*, 4(1), 1. doi:10.3390/cli4010001
- Unilever. (2014). *Sustainable living*. Retrieved from: <https://www.unilever.com/sustainable-living/>
- United Nation. (2021). *The Sustainability Development Agenda*. <https://www.un.org/sustainabledevelopment/development-agenda/>
- United Nations Asian and Pacific Training Centre for Information and Communication Technology for Development. (2013). *Primer series on ICTD for youth. Primer 4: An introduction to ICT, climate change and green growth*. Retrieved from https://www.preventionweb.net/files/47535_primer4ictclimatechange.pdf
- United Nations Environment programme (UNEP). (2012). *Business and Climate Change Adaptation: Toward Resilient Companies and Communities*. Available at: https://unglobalcompact.org/Issues/Environment/Climate_Change/
- United Nations Environmental Programme. (2016). *Green finance for developing countries: Needs, concerns and innovations*. Author.
- United Nations Framework Convention on Climate Change (UNFCCC). (2019). *Major Companies Face USD 1 Trillion in Climate Risks*. Available at: <https://unfccc.int/news/major-companies-face-usd-1-trillion-in-climate-risks>
- United Nations Framework Convention on Climate Change (UNFCCC). (2021). *What do adaptation to climate change and climate resilience mean?* Available at: <https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/what-do-adaptation-to-climate-change-and-climate-resilience>
- United Nations Framework Convention on Climate Change. (1994). *United nations framework convention on climate change: Convention*. Retrieved from https://unfccc.int/essential_background/convention/background/items/2536.php
- United Nations Framework Convention on Climate Change. (2011). *Climate change science – the status of climate change science today: Fact sheet*. Retrieved from https://unfccc.int/files/press/backgrounders/application/pdf/press_factsh_science.pdf

Compilation of References

- United Nations Global Compact. (2020a). *Our Governance*. UN Global Compact Office. <https://www.unglobalcompact.org/about/governance>
- United Nations Global Compact. (2020b). *The Ten Principles of the UN Global Compact*. UN Global Compact Office. <https://www.unglobalcompact.org/what-is-gc/mission/principles>
- United Nations Global Compact. (2021). *Our Participants*. UN Global Compact Office. [unglobalcompact.org/what-is-gc/participants/search?page=12&search%5Bcountries%5D%5B%5D=145&search%5Bkeywords%5D=&search%5Bper_page%5D=10&search%5Bsort_direction%5D=asc&search%5Bsort_field%5D=&utf8=✓](https://www.unglobalcompact.org/what-is-gc/participants/search?page=12&search%5Bcountries%5D%5B%5D=145&search%5Bkeywords%5D=&search%5Bper_page%5D=10&search%5Bsort_direction%5D=asc&search%5Bsort_field%5D=&utf8=✓)
- United Nations. (1987). *World Commission on Environment and Development, Our Common Future*. Oxford University Press.
- United Nations. (1992). *United Nations framework convention on climate change* (unfccc/formal/89.E.05-6222OLE)00705.9. New York: UN.
- United Nations. (1997). *Kyoto protocol to the United Nations framework convention on climate change*. UN.
- United Nations. (2015). *Transforming our world: the 2030 Agenda for Sustainable Development* (Report No. A/RES/70/1). United Nations. https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E
- United Nations. (2015). *Transforming our world: the 2030 agenda for sustainable development*.
- United Nations. (2016). *Women and Youth Entrepreneurship in Africa*. Available at: <https://www.un.org/en/africa/osaa/pdf/events/20160613/entrepreneurship-conceptnote.pdf>
- United Nations. (2019). Review of SDG implementation and interrelations among goals: Discussion on SDG 13 – Climate action including the link to the Climate Action Summit and six action portfolios. In *Global conference on strengthening synergies between the Paris Agreement on climate change and the 2030 Agenda for Sustainable Development* (pp. 1–99). Copenhagen, Denmark: United Nations.
- United States Agency for International Development. (2020). *Nigeria power Africa sheet*. Retrieved from <https://www.usaid.gov/powerafrica/nigeria>
- United States Energy Information Administration. (2020). *Biomass explained: Waste-to-energy (Municipal Solid Waste)*. Retrieved from <https://www.eia.gov/energyexplained/biomass/waste-to-energy.php>
- USDA (United States Department of Agriculture). (2013). Climate Change and Agriculture in the United States: Effects and Adaptation. *USDA Technical Bulletin*. https://www.usda.gov/oce/climate_change/effects_2012/CC%20and%20Agriculture%20Report%20%2802-04-2013%29b.pdf
- Uwuigbe, O. R. (2011). An Empirical Investigation of the Association between Firms' Characteristics and Corporate Social Disclosures in the Nigerian Financial Sector. *Journal of Sustainable Development in Africa*, 13(1), 60-74.
- Uygun, A., Musluk, B., & Ilbey, N. (2015). Examining the Influence of Green Management on Operation Functions: Case of a Business, *Research. Journal of Business and Management*, 2(3), 348–365.
- van der Bank, M., & Karsten, J. (2020, January). Climate Change and South Africa: A Critical Analysis of the Earthlife Africa Johannesburg and Another v Minister of Energy and Others 65662/16 (2017) Case and the Drive for Concrete Climate Practices. *Air, Soil and Water Research*, 13. Advance online publication. doi:10.1177/1178622119885372
- Van Eeden, S., Viviers, S., & Venter, D. (2004). An exploratory study of selected problems encountered by small businesses in a South African context. *Journal of African Business*, 5(1), 45–72. doi:10.1300/J156v05n01_04
- van Valkengoed, A. M., & Steg, L. (2019). Meta-analyses of factors motivating climate change adaptation behaviour. *Nature Climate Change*, 9(2), 158–163. doi:10.103841558-018-0371-y

- Van Wensveen, L. (2005). Cardinal environmental virtues: A neurobiological perspective. In R. Sandler & P. Cafaro (Eds.), *Environmental virtue ethics* (pp. 173–194). Rowman & Littlefield.
- van Zanten, J. A., & van Tulder, R. (2020). Towards nexus-based governance: Defining interactions between economic activities and Sustainable Development Goals (SDGs). *International Journal of Sustainable Development and World Ecology*, 1–17.
- Velte, P. (2021). Environmental performance, carbon performance and earnings management: Empirical evidence for the European capital market. *Corporate Social Responsibility and Environmental Management*, 28(1), 42–53. doi:10.1002/csr.2030
- Verticalroots. (2020). *The What and Why of Hydroponic Farming*. Available at: <https://www.verticalroots.com/the-what-and-why-of-hydroponic-farming/>
- Viinikainen, J., Heineck, G., Böckerman, P., Hintsanen, M., Raitakari, O., & Pehkonen, J. (2017). Born entrepreneurs? Adolescents' personality characteristics and entrepreneurship in adulthood. *Journal of Business Venturing Insights*, 8, 9–12. doi:10.1016/j.jbvi.2017.05.001
- Vijay & Natarajan. (2015). *Customer's awareness towards green banking products of the select commercial banks in Cuddalore district: An Empirical Assessment*. Academic Press.
- Vincent, I. (2020). *Implication of green marketing for a developing economy*. Department of Economics & Management Science, Nigeria Police Academy.
- Visser, W. A. M. T. (2002). Sustainability reporting in South Africa. *Corporate Environmental Strategy*, 9(1), 79–85. doi:10.1016/S1066-7938(01)00157-9
- Vitolla, F., Raimo, N., & Rubino, M. (2019). Appreciations, criticisms, determinants, and effects of integrated reporting: A systematic literature review. *Corporate Social Responsibility and Environmental Management*, 26(2), 518–528. doi:10.1002/csr.1734
- VOA Indonesia. (2019). *Wirausaha Sosial, Trend Bisnis Anak Muda*. Voa Indonesia. <https://www.voaindonesia.com/a/wirausaha-sosial-tren-bisnis-anak-muda/5171829.html>
- Volz, U. (2020). Investing in a green recovery: The pandemic is only a prelude to a looming climate crisis. *Finance & Development*.
- Vu, D. T., Yamada, T., & Ishidaira, H. (2018). Assessing the impact of sea level rise due to climate change on seawater intrusion in Mekong Delta, Vietnam. *Water Science and Technology*, 77(6), 1632–1639. doi:10.2166/wst.2018.038 PMID:29595165
- Wackernagel, M., & Rees, W. (1996). *Our Ecological Footprint: Reducing Human Impact on the Earth*. New Society Publishers.
- Waddell, R., Beal, D., & Cockerill, D. (2020). *Insurers Take Up the Climate Fight*. Retrieved from <https://www.bcg.com/publications/2020/insurers-take-up-the-climate-fight>
- Walker, H., Seuring, S., Sarkis, J., & Klassen, R. (2014). Sustainable Operations Management. *International Journal of Operations & Production*.
- Walls, J. L., & Hoffman, A. J. (2013). Exceptional boards: Environmental experience and positive deviance from institutional norms. *Journal of Organizational Behavior*, 34(2), 253–271. doi:10.1002/job.1813

Compilation of References

- Walz, M., & Günther, E. (2020). What effects does material flow cost accounting have for companies?: Evidence from a case studies analysis. *Journal of Industrial Ecology*.
- Wang, T., & Bansal, P. (2012). Social Responsibility in New Ventures: Profiting from a Long-term Orientation. *Strategic Management Journal*, 33(10), 1135–1153. doi:10.1002/mj.1962
- Wara, M., Cullenward, D., & Teitelbaum, R. (2015). Peak electricity and the clean power plan. *The Electricity Journal*, 28(4), 18–27. doi:10.1016/j.tej.2015.04.006
- Warner, K., Bouwer, L. M., & Ammann, W. (2007). Financial services and disaster risk finance: Examples from the community level. *Environmental Hazards*, 7, 32–39.
- Warren-Myers, G., Hurlimann, A., & Bush, J. (2020). Barriers to climate change adaption in the Australian property industry. *Journal of Property Investment & Finance*, 38(5), 449–462. doi:10.1108/JPIF-12-2019-0161
- Wasim, R. (2019). Corporate (non) disclosure of climate change information. *Columbia Law Review*, 119(5), 1311–1354.
- Watson, R., McCarthy, J., Canziani, P., Nicikenovic, N., & Hisas, L. (2019). *The truth behind Paris Agreement climate pledges*. Retrieved from: https://www.eurekalert.org/pub_releases/2019-11/tca-ttb110119.php
- Weber, O. (2018). The Financial Sector and the SDGs: Interconnections and Future Directions. *Centre for International Governance Innovation*, 201, 1–32. www.cigionline.org
- Weber, O., & Feltmate, B. (2016). *Sustainable Banking: Managing the Social and Environmental Impact of Financial Institutions*. University of Toronto Press. <https://utorontopress.com/us/sustainable-banking-4>
- Weitzman, M. L. (2009). On modeling and interpreting the economics of catastrophic climate change. *The Review of Economics and Statistics*, 91(1), 1–19. doi:10.1162/rest.91.1.1
- Weitzman, M. L. (2011). Fat-tailed uncertainty in the economics of catastrophic climate change. *Review of Environmental Economics and Policy*, 5(2), 275–292. doi:10.1093/reep/rer006
- Welsh, D. H. (2016). Women-owned family businesses in Africa: Entrepreneurs changing the face of progress. In *Family Businesses in Sub-Saharan Africa* (pp. 155–173). Palgrave Macmillan. doi:10.1057/978-1-137-36143-1_6
- Wenz, P. (2005). Synergistic environmental virtues: Consumerism and human flourishing. In R. Sandler & P. Cafaro (Eds.), *Environmental virtue ethics* (pp. 194–197). Rowman & Littlefield.
- Wessels, L., & Drennan, J. (2010). An investigation of consumer acceptance of Mbanking. *International Journal of Bank Marketing*, 28(7), 547–568. doi:10.1108/02652321011085194
- Westcott, M., Ward, J., Surminski, S., Sayers, P., Bresch, D. N., & Claire, B. (2020). Be prepared: Exploring future climate-related risk for residential and commercial real estate portfolios. *Journal of Alternative Investments*, 23(1), 24–34. doi:10.3905/jai.2020.1.100
- Westerman, J. W., Rao, M. B., Vanka, S., & Gupta, M. (2020). *Sustainable human resource management and the triple bottom line: Multi-stakeholder strategies, concepts, and engagement*. Academic Press.
- Westerman, Rao, Vanka, & Gupta. (2020). Sustainable human resource management and the triple bottom line: Multi-stakeholder strategies, concepts, and engagement. *Human Resource Management Review*, 30(3).
- Westman, L., Luederitz, C., Kundurpi, A., Mercado, A. J., Weber, O., & Burch, S. L. (2019). Conceptualizing businesses as social actors: A framework for understanding sustainability actions in small-and medium-sized enterprises. *Business Strategy and the Environment*, 28(2), 388–402. doi:10.1002/bse.2256

- Westpac. (2006). *Stakeholder Impact Report*. www.westpac.com.au
- Wetts, R. (2020). In climate news, statements from large businesses and opponents of climate action receive heightened visibility. *Proceedings of the National Academy of Sciences of the United States of America*, 117(32), 19054–19060.
- White, L., & Lee, G. (2009). Operational research and sustainable development: Tackling the social dimension. *European Journal of Operational Research*, 193(3), 683–682.
- Whiting, B. (2021). *Green Management: Cost Effectiveness and Benefits*. Retrieved from <https://study.com/academy/lesson/green-management-cost-effectiveness-benefits.html>
- Wieteska-Rosiak, B. (2020). Real Estate Sector in the Face of Climate Change Adaptation in Major Polish Cities. *Real Estate Management and Valuation*, 28(1), 51–63. doi:10.2478/remav-2020-0005
- Wikipedia. (2020). *Sustainability*. <https://en.wikipedia.org/wiki/Sustainability>
- Wilcox, J. W., & Fabozzi, F. J. (2013). *Financial Advice and Investment Decisions: A Manifesto for Change* (Vol. 195). John Wiley & Sons. doi:10.1002/9781118656761
- Wilenius, M. (2017). *Patterns of the future: Understanding the next wave of global change*. Academic Press.
- Wilhelm, K. (2013). *Return on sustainability: how business can increase profitability and address climate change in an uncertain economy*. FT Press.
- Willems, S., & Baumert, K. (2003). *Institutional capacity and climate actions*. Organisation for Economic Co-operation and Development (OECD) Environment Directorate International Energy Agency COM/ENV/EPOC/IEA/SLT(2003)5.
- Williams, F. L. (1991). *Theories and techniques in financial counseling and planning: A premier text and handbook for assisting middle and low income clients*. Purdue Research Foundation.
- Williamson, K., Satre-Meloy, A., Velasco, K., & Green, K. (2018). *Climate change needs behavior change: Making the case for behavioral solutions to reduce global warming*. Rare.
- Wilson, E. O. (1994). *The diversity of life*. Penguin.
- Wit, B., & Pylak, K. (2020). Implementation of triple bottom line to a business model canvas in reverse logistics. *Electronic Markets*, 30(4), 1–19. doi:10.1007/12525-020-00422-7
- Wittneben, B. B. F., & Kiyar, D. (2009). Climate change basics for managers. *Management Decision*, 47(7), 1122–1132. doi:10.1108/00251740910978331
- Wolf, D., & Klaiber, H. A. (2017). Bloom and bust: Toxic algae's impact on nearby property values. *Ecological Economics*, 135, 209–221. doi:10.1016/j.ecolecon.2016.12.007
- Wood, D.J. (1991). Corporate social performance revisited. *Academy of Management Review*, 16(4), 691–718. doi:10.5465/amr.1991.4279616
- Woods, B. A., Nielsen, H. Ø., Pedersen, A. B., & Kristofersson, D. (2017). Farmers' perceptions of climate change and their likely responses in Danish agriculture. *Land Use Policy*, 65, 109–120. doi:10.1016/j.landusepol.2017.04.007
- World Bank. (2017, September). Green sukuk set to become sustainable investment tools. *Islamic Finance Bulletin*, (27), 4.
- World Economic Forum (WEF). (2016). *The global risk report* (11th ed.). WEF.
- World Economic Forum. (2019). *The global risks report 2019*. Report.

Compilation of References

- World Economic Forum. (2020). *60% of the world's fish species at risk of extinction due to climate change*. World Economic Forum. Accessed from <https://www.weforum.org>
- World Economic Forum. (2020). *How businesses can build a sustainable future for all*. Available at: <https://www.weforum.org/agenda/2020/09/how-businesses-build-sustainable-future/>
- World Economic Forum. (2020). *What is green finance and why is it important?* Retrieved from <https://www.forum.org/agenda/2020/11/what-is-green-finance/>
- World Health Organisation (WHO). (2021). *Public health surveillance*. Available at: https://www.who.int/immunization/monitoring_surveillance/burden/vpd/en/
- World Health Organization. (2021). Health and climate change: country profile 2021: Fiji (No. WHO/HEP/ECH/CCH/21.01. 01). World Health Organization.
- World Meteorological Organization. (2019). *WMO confirms past 4 years were warmest on record*. Retrieved from <https://public.wmo.int/en/media/press-release/wmo-confirms-past-4-years-were-warmest-record>
- WorldFish Center. (2007). *Fisheries and aquaculture can provide solutions to cope with climate change*. *Fisheries and aquaculture can provide solutions to cope with climate change*. Issues Brief 1701, WorldFish Center.
- Wright, C., & Nyberg, D. (2017). An inconvenient truth: How organizations translate climate change into business as usual. *Academy of Management Journal*, 60(5), 1633–1661. doi:10.5465/amj.2015.0718
- WTTC. (2020). *Economic Impact Reports*. <https://wttc.org/Research/Economic-Impact>
- Wucker, M. (2016). *The gray rhino: How to recognize and act on the obvious dangers we ignore*. Macmillan.
- Wu, L., Subramanian, N., Abdulrahman, M. D., Liu, C., & Pawar, K. S. (2017). Short-term versus long-term benefits: Balanced sustainability framework and research propositions. *Sustainable Production and Consumption*, 11, 18–30. doi:10.1016/j.spc.2016.09.003
- Wu, L., Subramanian, N., Gunasekaran, A., Abdulrahman, M. D. A., Pawar, K. S., & Doran, D. (2018). A two-dimensional, two-level framework for achieving corporate sustainable development: Assessing the return on sustainability initiatives. *Business Strategy and the Environment*, 27(8), 1117–1130. doi:10.1002/bse.2055
- Wyman, O. (2020). *Climate change is an opportunity for business to thrive*. Retrieved from <https://www.oliverwyman.com/our-expertise/insights/2020/oct/climate-change-is-an-opportunity-for-business-to-thrive.html>
- Xia, Y., Li, Y., Guan, D., Tinoco, D. M., Xia, J., Yan, Z., Yang, J., Liu, Q., & Huo, H. (2017). Assessment of the economic impacts of heat waves: A case study of Nanjing, China. *Journal of Cleaner Production*. Advance online publication. doi:10.1016/j.jclepro.2017.10.069
- Xu, J., & Han, R. (2019). The influence of place attachment on pro-environmental behaviors: The moderating effect of social media. *International Journal of Environmental Research and Public Health*, 16(24), 5100. doi:10.3390/ijerph16245100 PMID:31847235
- Yahaya, O., & Nwabuogo, O. E. (2016). Renewable energy deployment as climate change mitigation in Nigeria. *Global Journal of Human Social Science*, 16(4). <https://globaljournals.org/item/6195-renewable-energy-deployment-as-climate-change-mitigationin-nigeria>
- Yazdi, S. K. (2012). Sustainable Tourism. *American International Journal of Social Science*, 1(1), 50–56.
- Yildiz, G., & Şeren, K. (2020). Tax as a Solution for Climate Change. *Contemporary Issues in Business Economics and Finance*, 104, 165–178. doi:10.1108/S1569-375920200000104011

- Yılmaz, B. S. (2007a). Turizmin sosyo-ekonomik, sosyokültürel ve çevresel etkileri. In Genel Turizm. Turhan Publishing.
- Yılmaz, B. S. (2007b). Turizm ve Çevre. In Genel Turizm. Turhan Publishing.
- Yılmaz, İ., Ünal, A., & Çakır, G. (2015). An evaluation on sustainable tourism literature: The context of Turkey. *MBD*, 4(2), 55-83. Retrieved from <https://dergipark.org.tr/en/pub/mbd/issue/34071/377077>
- Yılmaz, A. K., & Karakoc, T. H. (2008). Sustainability management based approach to global warming: Cgw Model and global warming factor score formula. *Journal of Management Research*, 1, 1–18.
- Yin, R. K. (2003). *Case study research, design, and methods*. SAGE.
- Yi, S., Li, X., & Jai, T.-M. (2018). Hotel guests' perception of best green practices: A content analysis of online reviews. *Tourism and Hospitality Research*, 18(2), 191–202.
- Yong, J. Y., Yusliza, M. Y., Ramayah, T., Chiappetta Jabbour, C. J., Sehnem, S., & Mani, V. (2020). Pathways towards sustainability in manufacturing organizations: Empirical evidence on the role of green human resource management. *Business Strategy and the Environment*, 29(1), 212–228. doi:10.1002/bse.2359
- Youmatter. (2020). *Climate Change: Meaning, Definition, Causes, Examples And Consequences*. Available at: <https://youmatter.world/en/definition/climate-change-meaning-definition-causes-and-consequences/>
- Yu, K. D. (2012). An economic analysis of the Philippine tourism industry. *DLSU Business & Economics Review*, 22(1), 119-128. <https://ejournals.ph/article.php?id=6450>
- Yu, Y. (2016). *Climate finance in and beyond the Paris agreement: Implementing climate finance commitments in Asia and the Pacific*. A Discussion Paper of Macroeconomic Policy and Financing for Development Division at First High-Level Follow-up Dialogue on Financing for Development in Asia and the Pacific, March 30th-31th, Incheon.
- Yu, S., & Xinpeng, X. (2019). The productivity impact of climate change: Evidence from Australia's Millennium drought. *Economic Modelling*, 76(1), 182–191. doi:10.1016/j.econmod.2018.07.031
- Yusoff, Y. M., Nejati, M., Kee, D. M. H., & Amran, A. (2020). Linking green human resource management practices to environmental performance in hotel industry. *Global Business Review*, 21(3), 663–680. doi:10.1177/0972150918779294
- Zaid, A. A., Jaaron, A. A., & Bon, A. T. (2018). The impact of green human resource management and green supply chain management practices on sustainable performance: An empirical study. *Journal of Cleaner Production*, 204, 965–979. doi:10.1016/j.jclepro.2018.09.062
- Zaitseva, N. A., Larionova, A. A., Takhumova, O. V., Eroshenko, V. I., Lebedeva, J. A., & Stadolin, M. E. (2019). Problems and directions of application of environmental technologies in the service sector. *Ekoloji*, 28(107), 489–494.
- Zamasiya, B., Nyikahadzo, K., & Mukamuri, B. B. (2017). Factors influencing smallholder farmers' behavioural intention towards adaptation to climate change in transitional climatic zones: A case study of Hwedza District in Zimbabwe. *Journal of Environmental Management*, 198, 233–239. doi:10.1016/j.jenvman.2017.04.073 PMID:28463773
- Zamora-Ramirez, C., & Gonzalez-Gonzalez, J. M. (2015). The Value of Climate Change Reporting of Firms: The Spanish Case. *International Journal of Social Ecology and Sustainable Development*, 6(4), 90–103. doi:10.4018/IJSESD.2015100107
- Zeithaml, V. A., Bitner, M., Gremler, D., & Pandit, A. (2013). *Services Marketing: Integrating customer focus across the firms* (6th ed.). Tata McGraw Hill Education Private Limited.
- Zeng, Y., Maxwell, S., Runting, R. K., Venter, O., Watson, J. E., & Carrasco, L. R. (2020). Environmental destruction not avoided with the Sustainable Development Goals. *Nature Sustainability*, 3(10), 795–798. doi:10.1038/s41893-020-0555-0

Compilation of References

- Zhang, Y., Lim, S., & Sharples, J. J. (2017). Wildfire occurrence patterns in ecoregions of New South Wales and Australian Capital Territory, Australia. *Natural Hazards*, 87(1), 415–435. doi:10.1007/11069-017-2770-1
- Zhang, Y., Wang, Q., Wang, Z., Yang, Y., & Li, J. (2020). Impact of human activities and climate change on the grassland dynamics under different regime policies in the Mongolian Plateau. *Science of the Total Environment*, 698, 1–10. doi:10.1016/j.scitotenv.2019.134304
- Zhang, K., Su, J., Xu, M., Zhou, Z., Zhu, X., Ma, X., Hou, J., Tan, L., Zhu, Z., Cai, H., Liu, F., Sun, H., Gu, P., Li, C., Liang, Y., Zhao, W., Sun, C., & Fu, Y. (2020). A common wild rice-derived BOC1 allele reduces callus browning in indica rice transformation. *Nature Communications*, 11(1), 1–15. doi:10.1038/41467-019-14265-0 PMID:31974373
- Zhang, X., Shen, L., & Wu, Y. (2011). Green strategy for gaining competitive advantage in housing development: A China study. *Journal of Cleaner Production*, 19(2-3), 157–167. doi:10.1016/j.jclepro.2010.08.005
- Zhao, C., Guo, Y., Yuan, J., Wu, M., Li, D., Zhou, Y., & Kang, J. (2018). ESG and corporate financial performance: Empirical evidence from China's listed power generation companies. *Sustainability*, 10(8), 1–18. doi:10.3390/s10082607
- Zhao, C., Yan, Y., Wang, C., Tang, M., Wu, G., Ding, D., & Song, Y. (2018). Adaptation and mitigation for combating climate change—from single to joint. *Ecosystem Health and Sustainability*, 4(4), 85–94. doi:10.1080/20964129.2018.1466632
- Zhou, N., Price, L., Yande, D., Creyts, J., Khanna, N., Fridley, D., & Franconi, E. (2019). A roadmap for China to peak carbon dioxide emissions and achieve a 20% share of non-fossil fuels in primary energy by 2030. *Applied Energy*, 239, 793–819. doi:10.1016/j.apenergy.2019.01.154
- Zhuang, J., Gunatilake, H. M., Niimi, Y., Khan, M. E., Jiang, Y., Hasan, R., Khor, N., Martin, A. L., Bracey, P., & Huang, B. (n.d.). *Financial Sector Development, Economic Growth, and Poverty Reduction: A Literature Review*. Asian Development Bank Economics Working Paper Series No. 173. doi:10.2139/ssrn.1617022
- Zhu, X., & Shek, D. T. L. (2020). Predictive Effect of Positive Youth Development Attributes on Delinquency Among Adolescents in Mainland China. *Frontiers in Psychology*, 11, 615900. doi:10.3389/fpsyg.2020.615900 PMID:33381073
- Zijp, M., Heijungs, R., van der Voet, E., van de Meent, D., Huijbregts, M., Hollander, A., & Posthuma, L. (2015). An Identification Key for Selecting Methods for Sustainability Assessments. *Sustainability*, 7(3), 2490–2512. doi:10.3390/s7032490
- Zimmerer, T.W., Scarborough, N.M., & Wilson, D. (2005). *Essentials of Entrepreneurship and Small Business Management*. Academic Press.
- Zubair, S., & Khan, M. (2019). Sustainable development: The role of green HRM. *International Journal of Research in Human Resource Management*, 2(1), 1–6.
- Zuo, J., & Zhao, Z. Y. (2014). Green building research—current status and future agenda: A review. *Renewable & Sustainable Energy Reviews*, 30, 271–281. doi:10.1016/j.rser.2013.10.021
- Zurich. (2016). *Four out of five SMEs fear impact of climate change on their business*. Zurich Insurance Group. <https://www.zurich.com/en/media/news-releases/2016/2016-1103-01>

About the Contributors

Odunayo Magret Olarewaju is a Chartered Accountant, Chartered Management Accountant, a Senior Lecturer and Acting Head of Department (Management Accounting) at the Durban University of Technology, South Africa. She has obtained all her degrees in Accounting field with several local and global accolades. She has mentored many postgraduate students' research to completion and has many other masters and doctoral students under her supervision in the area Accounting and Finance. Her research interests are Environmental Accounting, Corporate Governance, Sustainability Accounting, Financial Management, Managerial Accounting and Finance.

Idris Olayiwola Ganiyu has a PhD in Human Resource Management from the University of Kwa-Zulu-Natal in South Africa. The editor's research interests include but not limited to work-life balance, human capital development, diversity management, entrepreneurial ecosystem, and green manufacturing.

* * *

Michael Adelowotan is currently an Associate Professor in the Department of Accountancy of the University of Johannesburg, South Africa. His research interests are Integrated Reporting, Corporate Reporting Practices; Corporate Governance and Fourth Industrial Revolution Technologies.

Olufemi Patrick Adeyeye holds B. Sc., M. Sc., and Ph.D. all in Banking and Finance. He is a researcher and has published many scholarly papers in the field of Banking and Finance. He is presently the Deputy Dean, Faculty of Management Sciences, Federal University, Oye-Ekiti, Nigeria.

Olayinka Afolabi received a bachelor's degree in Business Administration from Caleb University Imota, Lagos and masters degree in production and operation Management from University of Lagos, Akoka, Nigeria. Her current field is in operation Management. She is interested in sustainable operation Management and operational performance. She is a wife and mother to a wonderful boy.

Temiloluwa Akinsola is an accounting educator at Bowen University, Nigeria. She is currently on her doctoral studies at the University of Johannesburg, South Africa. Her research interests include corporate governance with emphasis on board performance, strategic financial management, ethics, and corporate reporting.

Edidiong Samuel Akpabio is a lecturer in the Department of Political Science Trinity University, Yaba Nigeria. His research interest which include food security, social problems in Africa and a plethora of

About the Contributors

other sub-themes in African development were honed while undertaking postgraduate studies at the University of Benin. This has found more expression largely due to the fact that he teaches courses in African Politics. He is the author of the work *Attaining SDG's in Africa through Bilateral and Multilateral Partnerships* and recently Co-authored *Food Security and Social Protection in Africa: Re-establishing the Nexus* which appeared in the largest book project in human history on the UN Sustainable Development Goals published by Springer.

Omolola Ayobamidele Arise received her Master's degree in Cost and Management Accounting from the Durban University of Technology (DUT) in 2016. She was employed as a research assistant by DUT until 2017. She is an upcoming researcher, currently in the final year of her doctoral study. She has presented at different conferences and co-authored articles and book chapters.

Adepoju Adeoba Asaolu holds a Ph.D. in Banking and Finance from the University of Benin, was an astute banker with many years of cognate experience, and a researcher in banking and finance issues.

Ayansola Ayandibu holds a B.Sc Hons in Accounting, Masters of Business Administration and also a Ph.D in Leadership Studies. He has worked in the corporate environment for 8 years in Nigeria before relocating to South Africa. Dr. Ayandibu worked for Lieutenant Consulting, Midrand, Johannesburg in 2012 as an Accountant / Economist. He has been lecturing at University of KwaZulu Natal since February, 2013 till date in the Discipline of Management and Entrepreneurship. Ayansola has lectured Accounting, Management and Entrepreneurship modules in the University Of KwaZulu Natal. He has also published articles in accredited journals. Dr. Ayandibu has attended international conferences in the University of London, UK, Harvard University (USA) and Ryerson University, Toronto, Canada. Dr. Ayandibu is presently a Senior Lecturer in the Department of Business Management, University of Zululand. He is currently supervising Honours, Masters and Ph.D students. Dr. Ayansola Ayandibu is a member of South African Institute of Management (SAIM), South African Institute of Business Accountants (SAIBA) and Institute of Chartered Economist of Nigeria (ICEN).

Adekunle Alexander Balogun holds B. Sc., M. Sc. in Banking & Finance and Ph.D. in Finance. He is an academic member of the Department of Banking & Finance, Faculty of Management Sciences, Federal University Oye-Ekiti, Nigeria.

Niranjan Devkota is an economist with the expertise on climate change related issues focusing adaptation. He has over 10 years of experience in the field of economics related research with varietal dynamics. He has experience in impact analysis and model building. He received his PhD degree from Tribhuvan University Nepal in 2018.

Oladapo Fapetu holds B.Sc., M. Sc. and Ph.D. in Banking and Finance. He is currently a faculty member in the Department of Banking and Finance, Federal University Oye Ekiti, Nigeria.

Vanessa Gaffar is an associate professor of marketing in Faculty of Economics and Business Education, Universitas Pendidikan Indonesia. Her research interests are in the field of customer relationship management, social media, social marketing, tourism marketing, sports tourism, and entrepreneurship. Her works have been published in national and international journals, conference proceedings as well as books. She has been doing international research collaborations with partners from Thailand, Malaysia,

and the United Kingdom. She involved in TA-SE Erasmus Program with Deusto University in Spain and she is a member of the International Situation Project involving 62 countries with University of California, Riverside USA. She currently joins CALOHEA Project under Erasmus program with University of Groningen, Netherlands. Recently, she has just completed her two-year program as a visiting researcher at the Centre for Trust, Peace and Social Relations, Coventry University, UK.

Uzochukwu Ifeanyi is a certified animal scientist with over 10 years of experience in Animal production management and research. He obtained his B. Agric. (Animal Science) and M.Sc. in Animal Science (Animal Reproductive Physiology) degrees in 2011 and 2016 respectively, from the University of Nigeria, Nsukka, where he is currently engaged as a Lecturer in the Department of Animal Science. He is presently undertaking his Doctoral studies in Animal Science - Animal Reproductive Physiology, at the same Institution, and his research interest is in developing techniques for the improvement of growth, reproduction, and productivity of aquaculture and livestock species in a sustainable manner. As an expert in animal production, he has consulted for over 4 agro-based institutions, including Kaduna Catfish Farm, Kaduna, Nigeria, where he recently helped to achieve a marked increase in the farm's productivity and profitability. Ifeanyi has authored over 7 publications in peer-reviewed journals and is currently a certified member of 3 professional bodies, including the Animal Science Association of Nigeria (ASAN) and Nigeria Society for Animal Production (NSAP). Following his doctorate, he intends to leverage his experience to spearhead the development of comprehensive policies for ensuring the sustainability of local aquaculture and animal stock as a tool for improving animal protein intake in Nigeria.

Nnanna Ikeh is currently a Lecturer and Researcher with the Department of Animal Science, University of Nigeria, Nsukka. He is interested in improving animal production techniques and understanding how genetics plays a role in homeostasis and adaptation to our local and changing environment.

Ghanashyam Khanal is an economist with a special focus on Environmental & Resource Economics and Development Economics. He works on the intersection of development economics and the impact of development interventions on the environment. He is working as a Faculty of Department of Economics in Morgan International College, Tribhuvan University, Kathmandu, Nepal. He has published scholarly articles in several journals. Due to climate change, water resources have dried and there is increasing pressure of water scarcity around the world is another area where he would like to contribute. Moreover, he writes on the current issues of economics.

Tika Annisa Lestari Koeswandi, SS, MM, completed her bachelor's degree in the English Literature Study Program, Universitas Pendidikan Indonesia (UPI), then continued her master's program at the Management Study Program, School of Postgraduate Studies (SPs), Universitas Pendidikan Indonesia (UPI) and graduated with cum laude distinguish. Since 2018, she has started her career as a lecturer in the Entrepreneurship Study Program of Universitas Pendidikan Indonesia. Her research interests are in the fields of business communication, entrepreneurial marketing and social entrepreneurship. Besides actively translating & writing journal articles, she is also active in community service and business mentoring with USAID JAPRI and MicroMentor.

Haruna Maama is a lecturer at the Durban University of Technology, South Africa. He holds a PhD in Accounting from the University of KwaZulu-Natal (UKZN) in South Africa. Dr. Haruna Maama also holds two master's degrees in accounting (Master of Philosophy and Master of Business Administration).

About the Contributors

The author is also a member of Macroeconomics Research Unit (MRU) at the School of Accounting, Economics and Finance at UKZN. His research areas include integrated reporting, value relevance of accounting information, environmental reporting, green accounting and finance, corporate social responsibility reporting, financial reporting quality, corporate governance, climate change accounting and NFI disclosures.

Ndubuisi Samuel Machebe is a Professor of Animal Science and the current Head, Department of Animal Science, University of Nigeria, Nsukka. Prof. Machebe is a registered animal scientist and a member of the Nigerian Institute of Animal Science (NIAS). A Fellow of the Japanese Society for Promotion of Sciences (JSPS). HE is also an animal production consultant and an expert in animal reproductive physiology. With his over 20 years of experience in animal science teaching and research, he has graduated over 50 first degree animal scientist, 10 Masters of Science and 3 PhD students. He has well over 80 peer reviewed publications in Journals and conference proceedings. He has a wide visibility in both local and international scenes where animal agriculture and other related fields of agriculture is being discussed. Prof Machebe has mentored many young academic and has won many international research grants.

Makhosazana Magigaba attended the university of Zululand and studies social sciences where she had found a passion for Industrial Psychology. She completed her bachelor's degree and an honours degree in Industrial Psychology and had ambitions of registering as a professional psychologist. However, the best laid plans are often overhauled by destiny, as the young and energetic Dr Vezi-Magigaba or Nana to her friends, was asked to conduct a lecturing stint within the Faculty of Commerce, Administration and Law. Soon enough there was an opportunity to study in the United States, the Dean at that time recognised Dr Vezi-Magigaba as being the ideal candidate to represent the faculty, the university and the country as a whole at an international tertiary institution. After completing her MBA at the Jackson State University in the United States, Nana became enamoured towards all things business and subsequently took up her role as lecturer in the Department of Business Management at the University of Zululand. Over the years she ploughed back her knowledge in developing young minds towards business oriented careers. Her passion for entrepreneurship grew when she was asked to lecture this module, so much so that she became involved in an international student entrepreneurial body ENACTUS. Having coached the university students to measurable success in the national ENACTUS competition, she was rewarded with attending the ENACTUS world cup with her high-achieving stars. She has received numerous plaudits for her involvement in ENACTUS. She achieved all this by also playing the leadership role of Head of Department of Business Management. However, her crowning achievement was attaining her PhD amidst such work pressures under which most mortals will fold. Her active involvement and passion for ENACTUS inspired her PhD which was based on the influence of ENACTUS ON the growth of women-owned businesses within the region. She is in the process of publishing widely in the area on entrepreneurship and is slowly but surely becoming an expert in this academic field.

Sithokozile Mamba holds a Bachelor of Science in Marine Biology from the University of KwaZulu-Natal (UKZN), and a Postgraduate Diploma in Management (UKZN). further to that she is currently registered for her Master of Commerce in Management at UKZN. She has been an Ocean Steward for the KZN WildOceans.

Ferina Marimuthu is a Senior Lecturer and the Head of Department of Financial Accounting Department at the Durban University of Technology

Thabiso Sthembiso Msomi is a postgraduate student, Department of Management Accounting, Durban University of Technology, South Africa.

Khairunnisa Musari is an Assistant Professor of the Department of Islamic Economics, Postgraduate Program, and the Faculty of Islamic Business Economics, KH Ahmad Shiddiq State Islamic University (UIN)/State Institute for Islamic Studies (IAIN) of Jember. She is a Deputy Coordinator of Indonesia of Central Region for Central Board (DPP) of the Indonesian Association of Islamic Economist (IAEI), Secretary of Indonesian Economist Association (ISEI) of Jember, and Member of Expert Board of Islamic Economic Society (MES) of Lumajang. She has experiences as a Senior Specialist for Islamic Finance of United Nations Development Programme (UNDP) Indonesia. She was listed as the Top 300 Most Influential Women in Islamic Business & Finance 2019 and Top 150 Most Influential Women in Islamic Business & Finance 2020 by Cambridge-IFA. Now, she also becomes a Lead Independent Associate Ambassadors of VentureEthica. She has a great interest in sukuk, waqf, esham, fiscal & monetary policies, circular economy, halal logistics, and Islamic microfinance and nanofinance.

Bomi Nomlala is a senior lecturer in School of Accounting, Economics & Finance, University of KwaZulu-Natal Durban, South Africa.

Joan Nyika is a PhD researcher and lecturer at the University of South Africa and Technical University of Kenya, respectively. She obtained her Bsc and Msc in Biochemistry and Land and water management from Jomo Kenyatta University of Agriculture and Technology and the University of Nairobi in Kenya in 2011 and 2017, respectively. Her research entails vast areas in environmental science including climate change, waste management, land and water management and bioremediation processes towards sustainable environmental management. She has and is mentoring many undergraduate students, has published more than 20 articles and 15 book chapters in peer reviewed journals and books, respectively and has more than 5 years' experience in teaching and training at university level.

Zwelihle Wiseman Nzuzo is a lecturer in the Department of Management Accounting from the Durban University of Technology, South Africa in Durban. He teaches Financial Management and Management Accounting and has many years of experience in accounting education. He has published a number of research papers in the South African and International Journals. He is a Professional Accountant of South Africa (SAIPA) and holds a PhD in Management Sciences (with specialization in accounting research) and Master's Degree in Cost and Management Accounting.

Olusola Olawale Olarewaju is a doctoral student in Accounting at University of KwaZulu-Natal, South Africa. He has masters in accounting and masters in business administration. He has more than 10 years experience in investment and commercial banking.

Udaya Raj Paudel is a PhD scholar in TU, Kathmandu, Nepal working in the field of communication. His research works reflect communication, ethics, business and culture with latest practices worldwide. More than two decades of educational institution management and teaching English and Communication

About the Contributors

has propelled him as communication consultant in various organizations. Mr. Paudel projects commitments in research and ethical communication and consumption. He has presented his research ideas in different conferences/seminars and workshops. He has published in various journals and performed as reviewer for several journals.

Jayrusha Ramasamy-Gurayah completed a Bachelors degree of Social Sciences in 2001 at the University of Natal, an Honours degree at the University of Natal in 2002 and thereafter a Master's degree in Management at the University of Natal in 2003. She is currently working on her PhD in Supply Chain Management at the University of KwaZulu-Natal. Jayrusha commenced her career in Education in the private sector before moving to the public sector of South Africa, in the private sector of higher education, she lectured and worked as a Lecturer and supported accreditation committees to assist with the quality assurance processes. Jayrusha was the Regional Academic and Quality Assurance Manager for Damelin-KZN within the Educor Group from 2008 to 2011. In 2011, she began her academic journey in the public sector as a lecturer at the University of KwaZulu-Natal in the School of Management, IT and Governance in the discipline of Supply Chain Management. She is actively engaged in research and has presented papers at both national and international conferences. She currently supervises research students at Honours and Masters Levels and is an external examiner for a few tertiary higher education institutions and an external and internal moderator for supervision of Master's students.

Kiosha Ramlachan is currently an academic development officer at the University of Kwa-Zulu Natal (UKZN) in South Africa. She holds a Bachelor of Commerce degree in Human Resource Management (HRM) and Marketing Management. Furthermore, she holds a Bachelor of Commerce Honours degree in HRM, which she received cum laude. It was from this point she realised her passion and love for academia. She is currently pursuing her Master of Commerce degree in the discipline of HRM.

Andrisha Beharry Ramraj, lecturer at the University of KwaZulu-Natal, holds a PhD in Management studies majoring in management, leadership and governance. Further to this she holds a Diploma in Higher Education. In 2004 and 2005 she received NRF scholarships to complete her Honours and Masters degrees respectively. She has presented at local and international conference in the areas of Management, Leadership, Marketing, Global Business and Entrepreneurship. She has published in the fields of Leadership, Entrepreneurship, Human Resources and Business Management. She recently published book chapters on entrepreneurial suitability and employee wellness across the globe. In 2016 and 2017 she received best presentation awards for best paper delivered at conferences, she serves on the Teaching and Learning committee within the University of KwaZulu Natal (UKZN) and served as the Bachelor of Business Administrator Programme Manager (Self-Funding Teaching Programme) for a one term. She teaches across levels within the Discipline of Management and Entrepreneurship, from entry level to masters level. She is keen on developing undergraduate curriculum transformation within the discipline. Redesigning curricular to suite the dynamics of the modern world enabling sustainability is fast becoming her passion.

Prince Sarpong is a Senior Lecturer at University of the Free State (South Africa). He is the Founder of the Centre for Financial Planning Studies and a Financial Planning Consultant at Sarpong Wealth (Pty) Ltd. Dr Sarpong is a Certified Financial Planner professional and member of the Financial Planning Institute of Southern Africa. He holds a PhD and Master of Commerce in Finance from University

of KwaZulu-Natal, a Postgraduate Diploma in Financial Planning from Nelson Mandela University and a Bachelor of Education (Psychology) from University of Cape Coast.

Patricia Shewell is a Senior Lecturer in Managerial Accounting and Finance at the University of KwaZulu-Natal, Durban, South Africa. Area of research interest: Performance Management.

Adenike Soogun is a passionate, holistic, and goal-driven researcher and an adjunct lecturer at Management College of Southern Africa (MANCOSA) where she lectures marketing management, supply chain, research methodology, business mathematics, advanced business statistics, and analytical techniques. She has mentored many postgraduate research students to completion and has many other honours and masters students under her supervision in the area of marketing and business management, supply chain, banking and finance. Her research interest in the management area includes strategic marketing, econometrics, operational and marketing research. Adenike is also a Doctoral Research Fellow in Statistics at the Center for the AIDS Programme of Research in South Africa (CAPRISA), Durban. She is currently a Ph.D. student in Statistics at the University of KwaZulu-Natal, Durban South Africa. Adenike Oyelola Soogun MSc (Statistics), MBA, B.Sc (Statistics).

Valentine Chidozie Udeh is a Graduate Teaching and Research Assistant in the Department of Animal Science, University of Nigeria, Nsukka. He has a bachelor's degree in Animal Science and he is currently running a master's programme in the same field of study. His career objective is focused on the sustainable improvement of indigenous livestock species; promotion of animal welfare and the reduction of greenhouse gas emissions from the livestock sub-sector, through animal breeding and genetics.

Cigdem Unurlu is a lecturer at Trakya University in the department of Tourism and Hotel Management. She holds a Bachelor's Degree in Tourism and Hotel Management from Abant İzzet Baysal University and a masters and Ph.D. in business administration from Trakya University. Her research interests include consumer behavior, destination marketing and branding.

Ifeanyi Emmanuel Uzochukwu is a certified animal scientist with over 10 years of experience in Animal production management and research. He obtained his B. Agric. (Animal Science) and M.Sc. in Animal Science (Animal Reproductive Physiology) degrees in 2011 and 2016 respectively, from the University of Nigeria, Nsukka, where he is currently engaged as a Lecturer in the Department of Animal Science. He is presently undertaking his Doctoral studies in Animal Science - Animal Reproductive Physiology, at the same Institution, and his research interest is in developing techniques for the improvement of growth, reproduction, and productivity of aquaculture and livestock species in a sustainable manner. As an expert in animal production, he has consulted for over 4 agro-based institutions, including Kaduna Catfish Farm, Kaduna, Nigeria, where he recently helped to achieve a marked increase in the farm's productivity and profitability. Ifeanyi has authored over 7 publications in peer-reviewed journals and is currently a certified member of 3 professional bodies, including the Animal Science Association of Nigeria (ASAN) and Nigeria Society for Animal Production (NSAP). Following his doctorate, he intends to leverage his experience to spearhead the development of comprehensive policies for ensuring the sustainability of local aquaculture and animal stock as a tool for improving animal protein intake in Nigeria.

Index

A

access to finance 399, 401
 accounting profession 374-375, 377-378
 adaptation 2-3, 6, 9, 15, 31, 38, 54, 60, 72, 80-83, 94, 100, 116, 120-122, 124, 127-131, 133, 163, 167, 190-191, 194, 196-201, 206-209, 213-214, 218-229, 231-232, 240-243, 245-247, 249-251, 256-257, 263-265, 311, 374-375, 377-378, 380-386, 397-398, 404, 412, 418, 426, 430, 452, 458, 468, 473, 475-476
 adaptive risk management 244, 247
 agriculture 6, 24, 53, 103, 107, 129, 165, 202, 204, 208, 214-215, 220-226, 228, 246, 248, 254, 279, 311, 355, 364, 383-384, 390, 404, 406, 408, 413-414, 418, 449, 458, 465, 469
 air pollution 103-104, 183, 186, 233, 235, 248, 254, 308, 331-333, 335-337, 340, 349-352, 355, 466, 476
 auctioning 34-45, 47-49

B

Bankers Perspectives 84
 banking sector 52-53, 55, 58, 62, 86, 93, 95, 123, 182, 309, 389, 391, 398, 406, 411, 423, 429, 443
 banks 14, 30, 52-56, 58-66, 68-70, 84-98, 109, 118, 123-125, 127-128, 131-133, 218, 309, 318, 328, 354, 357, 360, 363-365, 367, 387-393, 395-398, 402, 406, 409, 412, 414, 416-419, 421, 424, 426-427, 432, 435, 437, 441, 443-444
 bases of power 238-239
 Black Swan 17-18, 30, 32
 board of directors 52, 55, 59-63, 68
 Burritt 290-292, 294-299, 302
 business practices 87, 99-100, 258, 286, 378, 442, 446

C

Carbon Disclosure 237, 242, 248, 390, 431, 433, 443

carrying capacity 267, 269, 272, 274-278, 280-284
 CBN 52, 55, 60-63, 65, 309, 426-427
 change process 161, 236, 238
 Christ 286, 290, 292, 294-299
 climate action 2, 9, 52-55, 59, 61, 63, 66, 167, 170, 175, 237, 385, 450, 462
 climate change 1-3, 5-6, 8, 13, 16-19, 22-32, 34-35, 38, 52-55, 60-62, 64-67, 71-83, 89, 99-101, 103, 105-132, 134, 144-148, 150, 152-154, 156-159, 161-172, 175-177, 179, 182-183, 185-194, 196-197, 199-266, 271, 286, 288, 312, 316-318, 325-327, 331, 353-356, 365-366, 368-369, 371-372, 374-391, 393, 395-400, 404-408, 411-414, 416-476
 climate change accounting 382, 431-444
 climate risk 17, 19, 23-25, 27, 29-30, 65, 72, 75, 83, 118, 127-130, 197-198, 227, 231, 242, 374-375, 377, 382, 387-393, 395-398, 419, 427-429, 444, 463, 467
 climate risk portfolio 17, 27
 Customers Perspectives 84

D

Deep Uncertainty 17-18, 22-24, 30
 deposit money banks 52, 55, 59, 61-62, 68, 309, 426
 devastating 20, 78, 137, 195, 199, 212, 215, 269, 417, 419
 disaster 75, 80, 103, 190, 193-197, 199-201, 213, 240, 248, 257, 264, 398, 419, 429, 468

E

earnings management 319, 329
 Eco-Adopter 185, 189
 Eco-Entrepreneur 185, 189
 Eco-Innovator 185, 189
 ecological footprint 85, 267, 269, 275, 278-279, 281, 284
 economic development 54, 97, 118-119, 121, 141, 152,

193, 232, 252, 255, 262, 268, 272, 274, 287, 306, 323, 366, 372, 395, 418, 447, 451, 459

economic growth 1, 9, 26, 54, 71, 79, 85, 100, 109-110, 121, 128, 175, 180-181, 190, 193, 232, 247, 252-253, 255, 257, 260, 267, 270, 289, 304, 307, 311, 313-314, 323, 367, 373, 401, 410, 449-451, 458

ecosystems 120, 145, 207, 209, 217, 229, 240, 268, 328, 461

emerging economies 52, 79, 187, 256, 262, 388

emissions 2-3, 7, 13, 24, 34, 36-37, 39, 49-50, 58, 60, 71-78, 83, 87, 100, 103-104, 108-109, 119-120, 122, 124, 131, 135, 145-146, 153-154, 172, 182-183, 186, 192-193, 198, 206-208, 215, 218, 220-221, 223, 234, 237, 240, 254, 260-261, 264, 271, 286-290, 293-295, 324, 356, 365, 368, 374, 377-378, 380, 386-387, 433, 435, 448, 453, 460, 464, 466, 468, 471-474

employees 60, 65, 88-89, 93, 99-103, 105-108, 111-114, 117, 141, 148, 150-151, 159, 166-167, 172-174, 183, 233, 235-238, 240-241, 244-247, 281, 292, 298, 302, 324, 360, 407, 425, 451, 466-467, 471-472

Enterprise Risk Management 396, 411-414, 425, 427-430

entrepreneurial activities 446-449, 452-456

entrepreneurship 96, 179, 187-189, 253, 261, 264, 301, 324, 328, 399-400, 406, 409-410, 447-448, 450, 452, 454-455, 457-459, 461

environmental concern 84, 169, 287, 289

Environmental Governance 52, 61, 63, 68

environmental impact assessment 141, 267, 269, 275, 277-278, 280-284, 292-293, 308, 312

Environmental management accounting 286-287, 291-292, 294, 299-302, 384

environmental sustainability 60, 62-63, 76, 86, 109, 132, 139, 142, 152-153, 155, 160, 260, 286, 299, 316-317, 353, 374, 376, 378, 407

Environmental, Social, and Governance (ESG) Committee 68

environments 113, 134, 148, 166, 190, 208, 218, 229-230, 235, 249, 331, 412, 434, 459

ESG 11, 29, 52, 54, 60-61, 65, 68, 431-432, 434, 436, 441, 443, 445

EU ETS 34-37, 41-45, 47-51

external factor 182-183, 186

extreme weather 31, 33, 72, 74-75, 79, 118, 121, 123, 125, 127, 144-145, 190, 198-199, 203, 206, 211, 217, 233-235, 237, 240, 243, 246, 249, 253, 256-257, 259, 381, 385, 388, 404, 412-413, 417, 426, 450-454, 464, 467, 471, 473

F

financial institutions 16, 24, 32, 55-57, 62-63, 66-68, 79, 86, 89, 91-94, 96, 124-125, 127, 195, 257, 260, 308-309, 312-313, 389, 402, 416, 418-419, 424, 426-427, 431-432, 434-442

financial performance 23, 142, 152-154, 166-168, 252, 259-262, 264-265, 291, 295, 298, 327, 353-354, 358, 363, 366-368, 370-371, 374, 384, 389-392, 395-396, 398, 434-435, 440-441, 443-445

financial planning 17, 19-23, 25-30, 32-33, 364

financial sector 2, 13, 52-56, 58-59, 67-68, 124, 131, 354, 357, 363, 368, 370, 373, 375, 388-389, 397, 406-408, 411-414, 416-419, 422, 425, 428-429, 432, 435, 442

financial services 14, 17, 20, 29, 58, 64-65, 94, 131, 200-201, 316-320, 322, 324-325, 353, 363, 366-368, 371, 379, 399, 401, 404-407, 409, 420, 423, 429

financial systems 118, 123-124, 126, 128, 406

food 1-2, 76, 80-81, 103, 110, 121, 136, 175, 190, 196, 199, 202-204, 206, 209-210, 212-213, 215-216, 218-219, 221-224, 226-227, 230-231, 254, 258, 263-264, 271, 279, 290, 297, 299, 301, 311, 356, 381-382, 449, 451, 453-454, 456, 458, 460, 465-466, 468, 471, 474, 476

G

global entrepreneurial initiatives 446, 453, 455

global warming 23, 32, 73-74, 76, 78, 82-83, 91, 99, 108, 110, 113-114, 118, 120-122, 124, 126, 129-131, 133, 148, 156-158, 164, 168-169, 191-192, 198, 204-205, 207, 229, 232, 250-251, 254, 290, 316, 326, 353, 355, 360, 362-363, 369, 372, 378, 380, 385, 412, 420, 424-425, 428, 433, 448, 473

globalisation 102, 111, 190, 236, 323

green banking practices 84, 86-95, 97

green building 71, 76-77, 83, 91, 178, 185, 328, 365

Green Differentiation 329

green electricity 304, 306, 309

green financing 1, 3, 13, 53, 184, 188, 353, 368

green marketing 316-317, 319-320, 325-326, 328-329, 353-363, 365-366, 368-373

green marketing mix 317, 325, 353, 357-358, 362-363, 368-369, 371

green marketing strategies 317, 320, 353, 360, 366, 368, 370

Green mission 353

green operations management 134-135, 141

Green Place 329, 359

green positioning 329, 368

Index

green practice 92, 171, 177-178, 185, 189, 254
green price 318, 329, 358, 368
green product 182, 188, 318-320, 328-329, 357-359,
361, 368
Green Project 1, 3-4, 6, 364
Green Promotion 329, 358-359
Green Report 1, 3
Green Segmentation 329
green strategy 171, 177, 185, 189, 321, 373
Green Sukuk 1-4, 6-9, 11-16
Green Swan 17-18, 22, 30, 129
Green Targeting 329
greenhouse gases 2, 18, 22, 36-38, 41, 103, 120, 193,
198, 207-208, 211, 240, 261, 290, 448, 453,
464-465, 476
Greenwashing 316-317, 319, 329
gross domestic product (GDP) 100, 122, 171-172, 181,
193, 254, 287, 387, 391

H

hospitality industry 184, 286-292, 297-300
human resource 66, 99-103, 105-106, 109-117, 143-
146, 148, 150, 152, 164-170, 303, 461
human resource development 109-110, 112, 116, 144-
145, 152, 164-166, 168-169

I

Ijara 16
individual learning and development 144
inflation 18, 20-23, 109, 121, 132, 193, 198-199, 399-
401, 408, 438
initiatives 2, 47, 52, 54-55, 57-58, 60-61, 63, 65, 76,
82, 85-86, 88, 91, 93-95, 97, 106-107, 126-127,
132, 142, 148-149, 151-154, 158, 161-162, 167,
184, 198, 213, 229-231, 238, 242, 246, 256, 259-
260, 287-290, 303, 319, 322, 324, 328-329, 374,
377-378, 380, 382, 389, 405, 420, 427, 429, 433,
447-448, 450, 452-453, 455-458, 467
innovation 2, 9, 13, 67, 108, 115, 121, 125, 147, 153,
175-176, 178, 181-182, 186-189, 253, 257, 261,
263, 305, 311, 317, 319-321, 325-328, 356, 366,
370, 372, 384, 409, 447, 449, 456, 458-459, 461,
469, 472
insurance 19, 22-24, 28, 31, 33, 53, 55, 59, 61-62, 64,
72-73, 75, 79-80, 121, 124-125, 129-130, 153,
165, 190-201, 213, 218, 234, 247, 257-260, 266,
316, 318-319, 326-327, 356, 363, 365, 371, 384,
388, 395-396, 404-405, 407-408, 411-412, 414,
418-429, 435, 465, 467, 474

insurance sector 73, 130, 191, 411, 423-425
insurers 23-24, 26, 32, 124, 126, 132, 191-192, 419-
420, 427, 467
integrated reporting 374, 378, 435, 442-443, 445
interest rates 20, 399-402
internal factor 181, 186
Islamic Finance 1, 14, 16
ISO 14051 286, 294, 296

L

litigations 199

M

managerial power 229, 238
manufacturing sector 418, 463-467, 469-471, 473, 475

N

Nepal 84-86, 88-93, 96-97, 104, 257
NSE 52, 61-62, 66, 69

O

occupational hazards 229, 233, 235, 245-246
operations 35, 39, 45, 53, 58, 60, 75, 85, 87-88, 93,
101, 108, 114, 131, 134-136, 138-143, 146, 162,
164, 166, 203, 218, 231, 240, 243, 245, 255, 292,
295, 312, 324, 356, 360-361, 366, 390-391, 396,
401, 404, 412, 433, 450, 453, 465-466, 468, 472
organisation 16, 38, 41, 48, 55, 68, 99-103, 105-108,
110-114, 122, 139, 149-155, 159-162, 190, 229-
234, 236-238, 240-247, 249, 251, 253, 257, 260,
287, 291, 294, 353, 355, 357, 360-361, 374, 376,
382, 433, 452, 455-456
organisational change and development 144, 155,
159, 161
organisational risk 229, 233-234, 246

P

performance 6, 20, 23, 28, 32, 56, 76, 86, 97, 100-101,
105-106, 110, 112, 114, 116-117, 122, 133, 135,
137, 142, 148-154, 160, 162-170, 179, 187-188,
209, 215-216, 243, 250, 252, 259-265, 284, 286-
287, 289, 291-295, 297-298, 303, 308, 317-320,
322-330, 334, 338, 344, 353-354, 356, 358, 360-
363, 366-368, 370-372, 374, 376, 384, 387-393,
395-398, 408-409, 434-435, 440-445, 460, 473
policy 2-3, 6, 14, 16, 22, 32, 34-36, 39-41, 49-50, 61-

- 63, 66, 68, 76-77, 81-82, 84, 86, 90-91, 94, 102, 108, 115, 117, 124, 126, 128-131, 133, 156-157, 162, 164-166, 169, 183-184, 187, 190-194, 198, 208, 218, 221-222, 224-225, 227-228, 243, 253, 262, 265, 268, 282, 294, 299, 312, 314, 323, 326-327, 349, 359, 361, 366, 368, 372, 374-377, 379-381, 383-385, 389, 395, 397, 405, 408, 417-419, 426-427, 442-443, 453, 456-457, 459-460, 467-468, 472, 474
- prevention 85, 116, 124, 194, 197, 213, 223, 244, 246, 250, 277, 292, 367, 390, 471
- Property ownership 71
- ## R
- real estate 23, 71-76, 78-83, 125, 174, 331-334, 338, 344, 349-351, 466
- regulatory bodies 52, 55, 61, 63, 68, 411
- renewable energy 26, 28, 35, 38, 55, 60, 82, 153, 167, 181-183, 185-188, 198, 208, 222, 228, 233, 254, 257, 279-280, 304, 308, 312-313, 377-378, 455-457, 471
- risk 2, 13-14, 17-30, 32, 41, 53, 56, 59-62, 64-65, 68, 71-73, 75-83, 87, 105, 108, 112, 118-120, 124-133, 144-145, 153-154, 156-158, 161-162, 165, 167-169, 179, 186, 190-201, 206-207, 214, 217, 227-235, 237, 241-248, 250-251, 253-254, 257, 259, 262-263, 309, 316, 324, 329, 351, 355-356, 361, 363, 365, 367, 371-372, 374-379, 381-385, 387-393, 395-398, 401, 405-409, 411-414, 416, 418-421, 423, 425-430, 432-433, 444-445, 459, 463, 466-471, 473-475
- risks 1, 13, 17-20, 22-29, 31, 53, 56, 59-60, 62, 71-73, 75, 77-79, 87, 100, 108-109, 112, 118-120, 123-132, 144-145, 149, 153-154, 156-158, 161, 190-196, 199-200, 203, 205, 230-233, 235, 237, 240, 242-244, 246-248, 250-251, 253-254, 257, 260-261, 264, 309, 312, 365, 375-377, 379-380, 383, 385, 387-388, 395-398, 402, 404-405, 409, 411-414, 416, 419-420, 423-430, 432-433, 456, 463, 466-467, 470, 472-474
- ## S
- SEC 55, 61-62, 64-65
- security 1, 3, 24, 80-82, 87, 90, 94, 116, 128, 131, 172, 174-175, 190-191, 194, 199, 202, 204, 206, 216, 218, 222-223, 226-227, 231, 243, 262-264, 334, 339, 344, 364, 366, 372, 381-382, 406, 413, 449, 454, 459, 466, 474
- Small business resilience 252
- socio-economic development 15, 267-268, 271
- stakeholders 2, 58-60, 85, 89, 91, 99, 114, 121-122, 152-153, 164, 176, 182, 185, 187-188, 199, 208, 246, 256, 260, 268, 273-274, 280, 284, 287, 291-292, 298, 322, 324-326, 353-354, 356, 360, 367-368, 389, 391, 411-413, 416, 419, 422-425, 427-428, 433-434, 440-442, 446, 472
- start-up 179, 184-185, 189, 248, 408
- state budget 2, 5, 34-35, 39, 42, 44-45, 47, 50
- Sukuk 1-4, 6-9, 11-16
- sustainability 2, 14-15, 27-28, 53-56, 58, 60-66, 68, 71, 73, 75-76, 81-83, 86, 90, 94-95, 99, 106-107, 109, 112, 114, 117, 119, 132-145, 149, 152-153, 155, 159-160, 164-165, 167-169, 172, 179, 186, 188-189, 202, 204-206, 208, 223, 225-226, 229, 231-232, 247, 249, 251-252, 255, 259-261, 263, 265, 267-279, 281, 284, 286, 288-289, 291-292, 294, 297, 299-301, 303, 316-317, 322-330, 353, 357-358, 360-361, 366-371, 374-380, 384-386, 388-389, 393, 396-398, 407-408, 432-435, 441-443, 445-448, 450, 454-462, 472, 474-475
- sustainability management 141, 152, 229, 231-232, 247, 251
- sustainability reporting 56, 62-65, 165, 317, 330, 370, 376, 378, 397-398, 433, 442-443, 461
- Sustainable Development Goals (SDGs) 3, 65, 89, 146, 166, 171-172, 175, 189, 379, 461
- sustainable tourism 64, 267-276, 280-285, 300-301, 460-461
- systematic risk 17, 416
- systemic risk 17, 125, 375
- ## T
- Traditional Place 318, 330
- Traditional Price 330
- Traditional Product 317, 330
- Traditional Promotion 318, 330
- triple bottom line 55, 64, 117, 135, 137, 353, 367, 372, 446, 450-451, 457, 459-462
- ## U
- underwriting 79, 125, 190, 196, 199, 420, 426
- unemployment 39, 101, 121, 253, 355, 400-401, 449, 451
- ## V
- value growth 431-432, 435, 439

Index

W

wakala 8-9, 16

Wakil 16

waqf 13, 15-16

waste 58, 60-61, 103-104, 106, 135, 162, 183, 186,
232, 248, 254, 258, 263, 267, 273, 279-281, 286,
288-308, 310-315, 320, 323-324, 354, 356-357,
362, 366, 368, 376, 432, 435, 460, 470-471

waste-to-energy strategy 304

weather conditions 71, 113, 190, 198, 203, 233-235,
240, 246, 256, 388, 390, 396, 404, 412-413,
417, 426, 448, 450-451, 454, 456, 463-465, 467,
472-473

West Africa 65, 185, 220, 431-432, 435-436, 438-
440, 442