Climate Change and Sub-Saharan Africa

The Vulnerability and Adaptation of Food Supply Chain Actors

Edited by

John K. M. Kuwornu
School of Environment, Resources and Development,
Asian Institute of Technology, Thailand

Series on Climate Change and Society

VERNON PRESS

www.vernonpress.com

In the Americas:
Vernon Press
1000 N West Street,
Suite 1200, Wilmington,
Delaware 19801
United States

In the rest of the world:
Vernon Press
C/Sancti Espiritu 17,
Malaga, 29006
Spain

Series on Climate Change and Society

Library of Congress Control Number: 2018961774

ISBN: 978-1-62273-265-4

TABLE OF CONTENTS

INTRODUCTION

The adverse effects of climate change and variability have become some of the biggest environmental and socio-economic challenges for society as a whole and food supply chain actors in particular. Climate change serves as a serious inhibitor to the attainment of food security (i.e., the availability, accessibility, stability and utilization of nutritious food and quality drinking water). Climate change has attracted the attention of the academic community, and governmental and non-governmental organizations. Numerous studies have examined the effects of climate change on food production and the livelihoods of farming households dependent on semi-subsistence agriculture for their continued existence.

Nevertheless, entire food supply chains are believed to be adversely affected by climate change and variability. The key questions are: How vulnerable are food supply chain actors (i.e., input suppliers, farmers, wholesalers, processors, middlemen, exporters, retailers) to climate change and climatic variability? What adaptation strategies are they adopting? How is the resilience of food supply chains being supported? By what means are they adopting the adaptation strategies? Are they being financed and/or supported by international organizations to cope with climate change? And what governmental support are they receiving to help cope with climate change? These and many related questions are addressed in this book.

This book empirically examines these issues to shed light on the effects of climate change across entire food supply chains with special reference to smallholder farmers, and to provide an exposition on the policy environment of climate change adaptation. This is a "must read book" and an essential resource for students, lecturers, researchers, agribusinesses, marketing firms, agricultural institutions, climate change adaptation institutions, policymakers and many others with an interest in agricultural development and the global food industry.

Editor
John K. M. Kuwornu

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Adaptation Policy Framework	APF
African Development Bank	AfDB
Agricultural Training Programme	ATP
Clean Development Mechanism	CDM
Climate Investment Funds	CIF
Climate Vulnerability Index	CVI
Community-based Health Planning and Services	CHPS
Demographic Health Survey	DHS
Divisional Delegate of Agriculture and Rural Development	DDARD
Environmental Protection Agency	EPA
Farmer Based Organization	FBO
Food and Agricultural Organization	FAO
Ghana Statistical Service	GSS
Global Climate Financing Mechanism	GCFM
Global Environmental Facility	GEF
Green Care Association	GCA
Household Vulnerability Index	HVI
Information Communication Technology	ICT
Institute of Statistical, Social and Economic Research	ISSER
Intergovernmental Panel on Climate Change	IPCC
International Air Passenger Adaptation Levy	IAPAL
International Development Research Centre	IDRC
International Institute for Environment and Development	IIED
International Institute for Sustainable Development	IISD
International Institute of Tropical Agriculture	IITA

International Maritime Emission Reduction Scheme	IMERS
Least Developed Countries	LDC
Livelihood Vulnerability Index	LVI
Ministry of Energy, Science, Technology and Innovation	MESTI
Ministry of Food and Agriculture	MoFA
National Association of Counties	NACO
National Adaptation Programme of Action	NAPA
National Oceanic and Atmospheric Administration	NOAA
Non-governmental Organization	NGO
Official Development Assistant	ODA
Organization of Economic Co-operation and Development	OECD
Pilot Program for Climate Resilience	PPCR
Propensity Score Matching	PSM
Roll Black Malaria	RBM
Shisong, Strategic Humanitarian Services	SHUMAS
Special Climate Change Fund	SCCF
Standard International Occupational Prestige Scale	SIOPS
Statistics, Research and Information Directorate	SRID
Strategic Priority for Adaptation	SPA
Third Assessment Report	TAR
United Nation Development Program	UNDP
United Nations Employment Programme	UNEP
United Nations Framework Convention on Climate Change	UNFCCC
Upper Nun Valley Development Authority	UNVDA
West and Central African Council for Agricultural Research and Development	WECARD
World Health Organization	WHO

LIST OF CONTRIBUTORS

John K. M. Kuwornu holds a PhD in Agricultural Economics and Marketing from Wageningen University, Netherlands. He is currently an Associate Professor in Agribusiness Management Field of Study at the School of Environment, Resources and Development, Asian Institute of Technology, Thailand. His areas of teaching and research include: Agribusiness Management, Agricultural Marketing and Trade, Agricultural Development, Agricultural Policy, Marketing Channels, Consumer Behaviour, Supply Chain Management, Commodity Futures Markets, Econometrics, Quantitative Methods, Climate Change, Food Security, Agrobiodiversity and Stock Markets.

Al-Hassan M. Ramatu has a BSc (Hons) Agriculture, MA Agricultural Economics and PhD Agricultural Economics. She is currently an Associate Professor at the University of Ghana, Legon. Her research area is in smallholder agricultural development in Ghana, including analysis of productivity, food security, poverty, and market access. Her areas of teaching are Research Methods, Production Economics, Farm Management, and Agriculture in Development Policy.

Derick T. Adu holds Master of Philosophy degree in Agricultural Economics from University of Ghana, Legon. He works as a Part-Time Lecturer in Faculty of Agriculture and Social Sciences at Anglican University College of Technology (Ghana), and a Project Officer at Freshmacs Ghana Limited. His teaching and research interests include Applied Econometrics, Managerial Economics, Macroeconomics, Environmental Economics, Climate Change Economics, Education Economics, Microeconomics, and Development Studies. He reviews for a number of reputable international journals. He has published in international peer-reviewed journals including Cogent Economics and Finance, Springerplus, Kasetsart Journal of Social Sciences, Cogent Food and Agriculture, and International Journal of Education Economics and Development.

Suhiyini Issah Alhassan is a Ghanaian by birth and Tamale is his home town. He holds Master of Philosophy degree in Agribusiness (University of Ghana), Bachelor of Arts degree in Development Studies (University for Development Studies, Ghana), Diploma in Education (University of Education, Winneba, Ghana) and a certificate in Information Technology (Technonet Ghana Ltd). Suhiyini is an educationist and works with The Ghana Education Service, Ministry of Education Ghana. He is also a researcher and engages in consultancy services for individuals, private enterprises and other Non-governmental Organisations. His research interest and expertise include but not limited to agribusiness, food security, climate change, supply and value chain management, land use management, poverty and small and medium scale enterprises development. He remains focused on developing himself as a distinguished researcher and welcomes new ideas in his field of research. He has an understanding of both quantitative and qualitative analytical tools. Hitherto, he had served as the Saboba district director of the ADPL Nationwide Farming Scheme and also the Team Leader of Enterprise Life Assurance Company Limited, Tamale. Suhiyini Issah Alhassan is currently a PhD student in the Department of Agricultural and Resource Economics, Faculty of Agribusiness and Communication Sciences, University of Development Studies, Tamale, Ghana.

Yaw B. Osei-Asare holds a PhD Development Economics from the University of Bonn, Germany. He is currently a Senior Lecturer in the Department of Agricultural Economics and Agribusiness, University of Ghana, Legon. He teaches Microeconomics and Macroeconomics, Quantitative Methods and Operations Research, and Environmental Economics. His areas of research interest include Environmental, Economic and Social Impact Assessments and Baseline Studies, Resource and environmental economics, ecosystem valuations, trade policy, poverty reduction and general economic policy issues.

Suiven John Paul Tume (Cameroon) has a Bachelor's Degree in Geography (2004), a Postgraduate Diploma in Education (2006) and Master's Degree in Geography (2008) all from the University of Buea. He is currently a PhD research fellow working on indigenous adaptations to climate change in the agriculture and water sectors. He volunteers at Green Care Association, Shisong—Cameroon as a researcher on indigenous climate change adaptation. He is also a consultant and volunteer researcher at Green Future Consulting where he works on climate change vulnerability and adaptation. He is a part-time instructor at the Department of Geography and Environmental Studies of the Catholic University of

Cameroon (CATUC), Bamenda and at the Department of Geography and Planning at the University of Bamenda. He has several publications in diverse subjects on climate change and the environment.

Mbu Dora Nyukighan (Cameroon) holds Bachelor's Degree in English Language from the University of Buea (1996), Post Graduate Diploma in Education from the National Teachers' Institute Kaduna, Nigeria (2009) and a master's degree in African Literature from the Ahmadou Bello University in Zaria, Nigeria (2012). She is a PhD research fellow on 'Gender Representations in Cameroon Drama of English Expression' at the University of Yaounde I. She is a lecturer in the Department of English and Literary Studies, Federal University Lokoja, Nigeria. She has carried out academic research on gender-related environmental issues in Anglophone Cameroon and papers articles on female power and empowerment, traditional and modern education of the Cameroonian child. She is interested vulnerability and adaptation of rural women to climate change in the Northwest Region of Cameroon.

Moye Eric Kongnso (Cameroon) holds a Bachelor's Degree in Geography and Environmental Management (2007) and a Masters Degree in Geography (Applied Agro-climatology, 2011), both from the Dschang. He is currently a PhD fellow. He is a member of a number of professional and research groups in environmental issues. He has co-published articles and book chapters on climate variability and change in the agriculture and water sectors.

Bankui Andrew Dzeaye (Cameroon) holds a Bachelors degree in International Business Management at the Furtwangen University of Applied Sciences, Germany and a Master's degree in International Management at the Fulda University of Applied Sciences, Germany. He has been Senior Project Manager in SHUMAS - Cameroon (Strategic Humanitarian Services - Cameroon) in partnership with the German Technical Cooperation (GIZ) for expatriates. He is an assistant lecturer at the Department of Agricultural Economics of the Catholic University of Cameroon (CATUC), Bamenda. He is currently working on his PhD thesis on economic and social impacts of adopting soil fertility management technology: the case of western highlands of Cameroon at the Faculty of Agronomy and Agricultural Sciences, University of Dschang.

Mairong Frederick Nsaikii (Cameroon) holds a higher teachers' diploma in biology, a bachelor's degree in biology and a master's degree in plant biology. He has several years of teaching experience in secondary and high schools. He is currently enrolled for a PhD at the Faculty of Agronomy and

Agricultural Sciences, University of Dschang. His research area is on climate change and food security in the Northwest region of Cameroon.

Njodzeka Gilbert Njodzeka (Cameroon) has a Diploma in Tree Nursery and Soil Conservation (1997) at Rural Training Centre (RTC), Mfonta. He is the Coordinating Manager and Head of Project Development at Green Care Association, Shisong—Cameroon. He is a crusader in combating environmental degradation through tree planting, apiculture, water catchment protection, developing renewable energy and animal husbandry through non-conventional livestock. He has won several international awards such as Bui Family Union, New Jersey Chapter–Appreciation of Service, 2010; United Kingdom-Commonwealth Mid-Career Fellowship (2010) and United Kingdom-World Environment Radio-First Prize, Best Feedback (2008).

Ali Essossinam is a lecturer. Essossinam teaches International Negotiation of Agricultural Products, Agricultural Finance, Microeconomics and Macroeconomics in Faculty of Economics and Management Sciences at University of Kara (TOGO) and Production Economics and Agricultural Policy in School of Agriculture at University of Lomé (TOGO). He has his Ph.D. in Applied Agricultural Economics and Policy from University of Ghana, Legon, Accra, (GHANA) and MSc in Applied Macroeconomics from University of Abomey Calavi-UAC, (BENIN) under the New Graduate Interuniversity Program (NPTCI). He got his MA and B.Sc degree in Economics from University of Kara (TOGO). The areas of research interests of Dr. ALI include Climate Change and Poverty, the Analysis of demand of Weather Index-based Insurance in Developing countries, the Economic Valuation of Non-market Commodities, Food Security Issues, Economic Impact Valuation Research, Agricultural Finance, and Environmental Issues.

Sampson Osei is a PhD candidate in Development Studies at the University of the Western Cape, South Africa. He holds Masters Degrees in Development Management and Development Studies from the Ruhr University, Germany and the University of the Western Cape, respectively.

Abdulrazak Karriem is a Senior Lecturer in the Institute for Social Development at the University of the Western Cape in Cape Town, South Africa. He received his PhD in City and Regional Planning from Cornell University. Prior to entering academia, he worked for the Department of Land Affairs in the Nelson Mandela government.

Abugri A. Stephen is an MPhil Graduate of the Agricultural Economics Programme in the University for Development Studies (UDS), Tamale, Ghana. He has a strong background in action and development research.

Dr. Joseph Amikuzuno holds a PhD Degrees in Agricultural Economics and is an expert in Price Transmission and Climate Change Impact analyses. He is currently a Senior Lecturer and the Head of the Climate Change and Food Security Department of the UDS.

Dr. Osman Tahidu Damba holds a PhD in Agricultural Economics from Ataturk University, Turkey, an MPhil in Agribusiness from the University of Ghana and BSc. Agricultural Technology from the University for Development Studies, Tamale, Ghana. Dr. Damba is currently a Lecturer at the Department of Climate Change and Food Security, Faculty of Agribusiness and Communication Sciences (FACS) at the University for Development Studies. He is focused on food security and climate change dynamics, Agricultural Markets, time series forecasting for volatility, value chains, FBO Development and agribusiness start-ups in developing countries. Dr. Damba has firm and extensive understanding in applied research and hands-on field practical techniques. He has extensive experience in the not-for-profit sector and has had stints with local and international organizations through roles at the Association of Church Development Projects (ACDEP) as a Market Access Coordinator, Farmers Organization Network in Ghana (FONG) as Agribusiness Cluster Officer, Pan African Organization for Sustainable Development (POSDEV) as a Project Officer as well as the International Fertilizer Development Center (IFDC) as a Business Development Advisor. Dr. Damba has further worked closely with several local farmer associations in capacity development and also facilitated linkages for Agricultural Commodity companies in Northern Ghana. Dr. Damba currently teaches Social and Environmental Impacts of Climate Change, Food Economics as well as Agricultural Finance and Farm Management at the graduate and postgraduate levels.

Armah Ralph Nii Armah holds an MPhil in Agricultural Economics from the University of Ghana. He is currently a Doctoral Candidate at Kansas State University, USA.

Mohammed Tiyumtaba Shaibu is a Senior Technologist working for Ghana's Council for Scientific and Industrial Research-Animal Research Institute. He had his education in Ghana and holds a BSc in Agricultural Economics and Extension and an MPhil in Agribusiness from the University for Development Studies and the University of Ghana respectively. He has one journal publication and 9 conference papers to

his credit. He has attended several workshops/trainings/short courses both locally and internationally. Shaibu's interest is in socioeconomics of livestock production including Crop-Livestock Systems, Agricultural Marketing, Agricultural Commodity Value Chains and Climate Change Adaptation of Farmers. He is currently implementing a project on climate change and variability implications for fodder production and goat value chains in Northern Ghana.

Dr. Franklin Kodzo Avornyo is a Principal Research Scientist who works at the Council for Scientific and Industrial Research – Animal Research Institute, Nyankpala Station near Tamale in Ghana. He holds an MSc. in Sustainable Agriculture and a PhD. His specialty is in Animal Science and has published works in the areas of improving livestock productivity, livestock value chains, integration of crop-livestock systems and climate change and livestock production interface. He has 25 refereed journal publications, 25 edited conference papers, one book and other publications to his credit. His interests include addressing challenges in the livestock sector.

Dr. Adelina Maria Mensah, a Senior Research Fellow at the Institute for Environment and Sanitation Studies (IESS), University of Ghana (UG), has an interdisciplinary background in environmental sciences with a focus on aquatic sciences and the human dimensions that impact on its management and sustainability. Dr. Mensah has worked extensively with numerous national and international institutions and stakeholders on a wide range of environmental and sustainable development issues, including aquatic ecosystem functioning, natural resource management, and climate adaptation. Her current interests are research and innovation in science and technology for promoting sustainable futures.

Dr. Elaine Tweneboah Lawson has over 14 years' experience in teaching, research and academic programme coordination at the University of Ghana. Her teaching and research have focused on coupled human-environment systems at a variety of scales. Her research interests include climate change adaptation, coastal ecosystems, dimensions of poverty, environmental policy processes, gender, and social dimensions of zoonotic diseases. Dr. Lawson has a doctorate degree in Environmental Resource management from the Brandenburg University of Technolgy, Cottbus, Germany.

Prof. Christopher Gordon holds Bachelor of Science and Master of Science degrees in Zoology from the University of Ghana, Legon and a UNESCO Post-Graduate Certificate in Limnology awarded by the Austrian

Academy of Sciences. He has a Doctorate degree in Human Environmental Sciences from King's College, University of London, United Kingdom. He has a distinguished academic career spanning over thirty years at the University of Ghana in the fields of research, teaching as well as advisory and fundraising services at both local and international levels. He has successfully supervised over 100 graduate students, - two of whom have won the Silver Medal of the Ghana Academy of Arts and Sciences for Best Post-graduate thesis in Ghana.

Dr. Avishek Datta is an Associate Professor of Agricultural Systems and Engineering Programme at the Asian Institute of Technology, Thailand. He obtained his PhD in Agronomy from the University of New England, Armidale, New South Wales, Australia and conducted his Postdoctoral Research at the University of Nebraska-Lincoln, Nebraska, USA. He has more than ten years of experience working in multidisciplinary agricultural research and development activities. His main areas of expertise include crop production under conventional and organic farming systems in relation to food security and climate change.

FOREWORD
BY SURESH BABU

Achieving UN Sustainable Development Goals will greatly depend on how developing countries tackle the deleterious consequences of the climate change on the welfare indicators. While the governments of the developing countries are trying to address the issue of climate change and develop measures to mitigate and adapt to the changing environments, they are often faced with limited information on the indicators and causal factors that affect the food system in general and the food supply chains in particular.

In this book, Dr. John Kuwornu compiles a set of studies that deal with several key policy and programmatic issues related to adaptation of the key actors and players of the food supply chains. The chapters of this book address the nature of the adaptive measures the actors of the food supply chains take to manage the effects of climate change. The chapters also address the challenges related to building resilience of the food supply system.

The case studies compiled in this book are also useful as cross-community learning as the context of the chapters take us through various scenarios under which the vulnerable nature of the food systems is managed through adaptive measures. The book will be an essential reference for those involved in analyzing the effects of climate change on the socioeconomic conditions of actors in food supply chains in Africa and rest of the World.

Dr. Suresh Babu
Head, Capacity Strengthening,
International Food Policy Research Institute,
Washington D.C.

FOREWORD
BY VENKATACHALAM ANBUMOZHI

One aspect of the climate change that has been studied with fewer details so far is related to its economic impacts along the food value chain. This is due, perhaps, to the intrinsic complexity among the different actors that characterizes long-term social predictions and short-term adaptation measures. The truth is that some communities in the food value chain will suffer severe vulnerabilities from the new climate conditions.

We should worry more about the food value chains and the communities associated with that, which have never enjoyed technological advances but adjusted with ecosystem-based adaptation measures, but now see their economic welfare is threatened by accelerated climate risks. For instance, farming communities from sub-Saharan Africa, whose lands are increasingly becoming less productive and dry, providing testimony of what might happen in other parts of the world such as South East Asia, if the average temperature rises more than 2^0 C. The vulnerability of food value chains to climate change in terms of geography and timescale have diverse difficulties to understand the consequences for the major crops and small-scale farming communities.

This book explores the impacts of climate change on a wide variety of value chains and places in Sub-Saharan Africa, their vulnerabilities, and mitigative and adaptive capacities. In this book, we find a very useful exploration of agronomic and economic approximations connected to these consequences as well as innovative ideas of micro and macro adaptation along the value chain. For sure, the new assessment tools and adaptation measures developed in the chapters of this book will be extremely helpful for building an accurate diagnosis and to achieve a greater resilience of small-scale farming communities, all of which face the long-term consequences of climate change.

Dr. Venkatachalam Anbumozhi
Senior Economist
Economic Research Institute for ASEAN and East Asia (ERIA), Jakarta, Indonesia

FOREWORD
BY JOYASHREE ROY

Several recent expert opinion-seeking surveys show that hunger is one of the 17 SDGs with the greatest potential and chance of being solved in the next decade. However, this will need multi-dimensional strategies. IPCC's 'Special report on Global Warming of 1.5°C above pre-industrial levels and the likely impacts and pathways in the context of strengthening the global response to the threat of climate change, sustainable development and efforts to eradicate poverty' reports high confidence in a relatively reduced impact but it still reports an increase in climate-related risks to food security at 1.5°C compared to 2°C and the disproportionate effect on vulnerable populations that are dependent on agriculture and coastal livelihoods in dryland regions and less developed countries. Overlapping risks across livestock, water, energy, and food exacerbate current hazards, exposure and vulnerabilities. Regional examples are limited by the availability of local scale studies. Also, the assessment is confident in the role of redistributive policies to ameliorate adverse impacts on already disadvantaged populations of multiple mitigation options when accelerated and scaled up in the short window of opportunity within the next decade.

This present book, based on mostly field level first-hand primary evidence from within Africa, can be considered as a major contribution to the bridging of this knowledge gap through methodological rigor. The selected articles for this volume bring up one point very clearly that in Africa there is diversity in vulnerability and exposure. Hence, the resultant risks to households, farmer groups, region-specific crop varieties, and subnational administrative units highlight the need for a wide variety of attention and interventions towards adaptive capacity enhancement and risk reduction. The vulnerability of particular crop varieties, communities, indigenous populations, farmer categories by gender and responsible climate parameters are well covered. Offering regional diversity through studies of Ghana, Cameroon, and Togo, high-quality sets of data are presented that could inform global assessments. The book not only focuses on the food production system and producers' vulnerability but

also on the vulnerability of the supply chain is also assessed in relation to Uganda. Policy recommendation provides a starting point for a more extensive research agenda to understand what works better under what circumstances.

In this book, the conclusions based on empirical evidence from various studies support the portfolio approach by taking into consideration synergies and tradeoff among multiple SDGs, which are also mentioned in the assessment of the IPCC special report on the global warming of 1.5°C.

The new granular insights brought up by the various articles in the book are very useful for informing the larger global debate. From an intellectual point of view, the editor's compilation of articles that study various regions of Africa and the arrangement of each article in a similar format helps in the understanding of the vulnerability and adaptation of farmers and other food supply chain actors to climate change.

The articles in this book will be of considerable interest and use to the authors of the IPCC Sixth Assessment Report and the development community including academia and decision makers like national governments, bilateral and multilateral funding agencies, and civil societies engaged in developmental actions in the region. This book will generate interest for further studies in Africa and in other countries in order to advance deeper regional and global debate, struggle and understanding.

Joyashree Roy
Bangabandhu Chair Professor
Asian Institute of Technology, Thailand
Professor of Economics (On lien) and Founder Advisor to Global Change Programme & SYLFF-JU Programme of Jadavpur University, India.

PREFACE

This book provides an exposition on the effects of climate change on food supply chains. It seeks to explore the effects of climate change at the farm level, the effects on intermediaries in the food supply chains, and the role of policymakers and international institutions regarding adaptation to climate change.

Chapter 1 by Derick T. Adu and John K. M. Kuwornu provides an overview of the policy environment of climate change adaptation.

Chapter 2 by Suhiyini Issah Alhassan, Yaw Bonsu, Osei-Asare, and John K.M. Kuwornu examines the vulnerability of women rice farmers to climate variability in the Northern Region of Ghana using the Livelihood Vulnerability Index Approach.

Chapter 3 by Suiven John Paul Tume, Mbu Dora Nyuykighan, Moye Eric Kongnso, Bankui Andrew Dzeaye, Mairong Frederick Nsaikii, and Njodzeka Gilbert Njodzeka assesses food crop vulnerability to due climate variability and change at the household level in Bui Division in the northwest of Cameroon.

Chapter 4 by Ali Essossinam examines the farm households' perception of climate change, traditional beliefs and determinants of the adaptation decisions in northern Togo.

Chapter 5 by Sampson Osei and Abdulrazak Karriem examines social capital and climate change adaptation among smallholder farmers in the Central Region of Ghana.

Chapter 6 by Suhiyini Issah Alhassan, Yaw Bonsu Osei-Asare, and John K.M., Kuwornu examines the factors influencing women rice farmers' vulnerability to climate change in the Northern Region of Ghana.

Chapter 7 by Armah Ralph Nii Armah, Al-Hassan M. Ramatu, John K. M. Kuwornu examines the impact of participation in climate change projects on maize farmers' resilience to climatic shocks, yields and income.

Chapter 8 by Mustapha Abubakar Sadiq, Al-Hassan M. Ramatu, John K. M. Kuwornu examines the vulnerability of smallholder maize farming households to climate variability in the Eastern Region of Ghana.

Chapter 9 by Suhiyini Issah Alhassan, John K.M. Kuwornu, and Yaw Bonsu Osei-Asare examines the climate change adaptation strategies by women rice farmers in the Northern Region of Ghana.

Chapter 10 by Mohammed Tiyumtaba Shaibu, Suhiyini Issah Alhassan, Franklin Kodzo Avornyo, Elaine Tweneboah Lawson, Adelina Mensah and Christopher Gordon explores the perceptions and determinants of adoption of indigenous strategies for adaptation to climate change by smallholder livestock farmers in the North-Western Region of Ghana.

Chapter 11 by Joseph Amikuzuno, John K. M. Kuwornu and Damba, T. Osman examines gender-based climate change impacts and adaptation strategies among smallholder farmers in northern Ghana.

Chapter 12 by Derick T. Adu, John K. M. Kuwornu and Avishek Datta explores smallholder maize farmers' constraints to climate change adaptation strategies in the Brong-Ahafo Region of Ghana.

Chapter 13 by John K. M. Kuwornu and Derick T. Adu provides a general discussion on the vulnerability and adaptation of food supply chain actors to climate change.

Finally, chapter 14 by John K. M. Kuwornu provides conclusions and recommendations regarding the vulnerability and adaptation of food supply chain actors to climate change.

ACKNOWLEDGEMENTS

I would like to thank all the authors for their invaluable contributions this book. My special appreciations also go to the reviewers of the individual chapters and the entire book. I am really grateful to Mr. Derick T. Adu for formatting the text in the book. My special gratitude also goes to Vernon Press for publishing this book. Thanks also to Dr. John Meadows for proofreading the final draft of the manuscript.

PAGES MISSING

FROM THIS FREE SAMPLE

INDEX

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Y

Z