

INSTITUT FÜR RAUMORDNUNG UND ENTWICKLUNGSPLANUNG

of



UNIVERSITÄT STUTTGART

**ASSESSMENT OF VULNERABILITY AND CLIMATE RISKS IN WA CITY REGION
WITH SPECIAL FOCUS ON URBAN-RURAL LINKAGES**

A Thesis Submitted to the Institut für Raumordnung und Entwicklungsplanung,
Universität Stuttgart, in partial Fulfillment of the Requirements for the award of a Master of
Science Degree in Infrastructure Planning

By

Daniel Dambeebo

3210813

November, 2018.

DECLARATION

I hereby declare that; this Thesis is the original work conducted by me towards the award of a Master of Science Degree in Infrastructure Planning at the Universität Stuttgart. This Thesis has not been submitted anywhere for another degree including the Universität Stuttgart.

Name: **Daniel Dambeebo**

Matriculation Number: **3210813**

Stuttgart, Date

Signature

First Supervisor,

Prof. Dr.-Ing. habil. Jörn Birkmann

Institut für Raumordnung und Entwicklungsplanung (IREUS)

Universität Stuttgart

Pfaffenwaldring 7

70569, Stuttgart.

Second Supervisor

Dr. rer. nat. Hans-Georg Schwarz-v. Raumer

Institut für Landschaftsplanung und Ökologie (ILPÖ)

Universität Stuttgart

Keplerstr. 11

70174, Stuttgart

DEDICATION

To Jehovah, the Ancient of Days

ACKNOWLEDGEMENT

I wish to express my profound gratitude to Prof. Dr.-Ing. habil. Jörn Birkmann, of the Institut für Raumordnung und Entwicklungsplanung, Universität Stuttgart for his unwavering support in shaping my research topic. I am forever grateful for his time, useful comments, and suggestions, irrespective of his extremely busy schedules.

I equally express my deep appreciation to Dr. rer. nat. Hans-Georg Schwarz-v. Raumer, Institut für Landschaftsplanung und Ökologie, Universität Stuttgart for his time, effort, support and guidance in the course of the study. I am highly grateful.

I owe a lot to the Deutscher Akademischer Austauschdienst for funding my entire study in Germany. The purpose would be fulfilled.

I am highly indebted to my parents, wife, and friends especially Jalloh for all their support.

ABSTRACT

Climate change has become a development issue globally, with developing and emerging economies bearing the highest impact. This is due to inadequate resources, poor infrastructure, weak institutions and systems, which are prerequisites for preparedness, mitigation and adaptation efforts. The phenomenon is complicated as resources meant for development is drawn to fight the impact of climate change. Empirical evidence shows that, Sub-Saharan Africa, South Asia and Latin America would more likely endure the highest impact.

This study assessed vulnerability and climate risks at the local level, particularly threats to livelihood security, internal migration and how urban-rural linkages exacerbate these issues. The study further sought answers to the state of awareness of climate change impact, how poverty and inadequate education are contributing to climate vulnerability in the study region. Further, what institutions are doing, in the form of governance to enhance resilience and mitigate the adverse impacts of climate change.

The study adopted a mixed approach in the design encompassing both elements of qualitative and quantitative approaches respectively. About 185 households, both in the city and within the hinterland were surveyed for responses. Institutions, which are at play within the study region, whose governance style and structure has implications on climate issues, were interviewed. Women groups were also made an integral part of the study because of their less representation in the household leadership structure within the study location. This was conducted in the form of a Focus Group Discussions.

The study revealed that, closed to half of the population were not abreast with issues surrounding climate change. They had less or no information regarding the phenomenon. It further discovered that, smallholder farmers within the hinterland had their livelihoods threatened by climate change impact. This happened through pest and diseases on livestock, erratic rainfall pattern, inadequate arable lands and conflicting use of resources between the urban dwellers and smallholder farmers within the hinterland. One of the resulting consequences has been internal migration. Institutional governance is weak, and woefully inadequate.

The author strongly recommends that, government and its development partners must formulate and design appropriate policies, programs, and projects that are founded on proper needs assessment with communities onboard.

TABLE OF CONTENT

Table of Contents

DECLARATION	i
DEDICATION	ii
ACKNOWLEDGEMENT	iii
ABSTRACT.....	iv
TABLE OF CONTENT	v
LIST OF TABLES	ix
LIST OF FIGURES	x
LIST OF ACRONYMS AND ABBREVIATIONS	xi
CHAPTER ONE	1
GENERAL INTRODUCTION.....	1
1.1 Background.....	1
1.1 Problem Statement	4
1.2 Research Questions	7
1.3 Research Objectives	7
1.4 Relevance of the Study.....	8
1.5 Scope of the Study.....	10
1.5.1 Geographic Scope	10
1.5.2 Contextual Scope	10
1.7 Limitations of the Study.....	10
1.8 Organization of the Report.....	10
CHAPTER TWO	11
LITERATURE REVIEW	11
2.1 Introduction.....	11
2.2 Conceptual Review	11
2.2.1 Climate Variability.....	11
2.2.2 Climate risk.....	13
2.2.3 Climate vulnerability	14

2.2.4 Migration.....	16
2.2.5 Resilience to Climate Change.....	17
2.3 Theoretical Review.....	18
2.4 Empirical Review.....	19
2.4.1 Vulnerability and climate change risk.....	19
2.4.2 Awareness of climate change impact.....	25
2.4.3 The influence of urban-rural linkages on vulnerability and livelihood security.....	27
2.4.4 Climate variability and internal migration.....	28
2.4.5 Institutional governance to enhance resilience and adaptive capacity.....	31
2.5 Conceptual Framework.....	33
2.6 Conclusion.....	37
CHAPTER THREE.....	38
METHODOLOGY.....	38
3.1 Introduction.....	38
3.2 Study Context.....	38
3.3 Research Design.....	40
3.4 Target Population.....	41
3.5 Sampling.....	42
3.5.1 Sample size.....	42
3.5.2 Procedure for selection.....	43
3.6 Sources of data.....	43
3.7 Methods and Tools of Data collection.....	43
3.7.1 Questionnaire.....	43
3.7.2 Key Informants Interview.....	44
3.7.3 Focus Group Discussion.....	44
3.8 Method of data analysis.....	45
3.9 Analytical Framework.....	45
CHAPTER FOUR.....	49
RESULTS AND DISCUSSION.....	49

4.1 Introduction.....	49
4.2 Background Information of Respondents	49
4.3 Awareness of climate change impact.....	51
4.3.1 Awareness	51
4.3.2 Rural and Urban difference in access to information	52
4.3.3 Sources of information on climate change.....	53
4.4 Vulnerability and climate change risk	54
4.4.1 Climate change and livelihoods	54
4.4.2 Vulnerability	55
4.4.3 Crop performance in the presence of climate variability	57
4.4.4 Vulnerability in rural and urban households.....	59
4.5 The influence of urban-rural linkages on vulnerability and livelihood security.....	60
4.5.1 Rural-urban linkages	60
4.5.2 Urban rural linkages.....	62
4.5.3 Satisfaction with current location	63
4.5.4 Availability of shared resources in rural and urban areas	63
4.6 Climate variability and internal migration	65
4.6.1 Migration in the past ten years	65
Figure 4.4: Migration of households in the past ten years	65
4.6.2 Direction of movement	66
4.6.3 Reasons for migration	66
4.6.4 Relocation after adaptation to climate variability	69
4.7 Institutional governance to boost resilience and adaptive capacity	70
4.8 Focused Group Discussion	72
CHAPTER FIVE	75
GENERAL DISCUSSION, SUMMARY, CONCLUSION AND RECOMMENDATIONS.....	75
5.1 Introduction.....	75
5.2 General discussion of Findings.....	75

5.3 Specific Findings to Research Questions.....	78
5.3.1 Awareness of climate change impact.....	78
5.3.2 Vulnerability and climate change risks.....	78
5.3.3 The influence of Urban-rural linkages on vulnerability and food security.....	79
5.3.4 Climate variability and internal migration.....	80
5.3.5 Institutional governance to boost resilience and adaptive capacity.....	80
5.3.6 Grey Areas.....	81
5.4 Conclusion.....	82
5.5 Recommendations.....	83
REFERENCES.....	86
APPENDICES.....	92
Questionnaire for households within the hinterland.....	92
Questionnaire for households within the city.....	95
Universität Stuttgart, Germany.....	98
Questionnaire for the Wa Municipal Assembly.....	98
Questionnaire for the Municipal Agricultural Development Unit.....	100
Questionnaire for the Environmental Protection Agency (EPA).....	103
Universität Stuttgart, Germany.....	105
Questionnaire for the Forest Services Commission (FSC).....	105
Universität Stuttgart, Germany.....	107
Questionnaire for the Town and Country-Planning Department (TCPD).....	107
IMAGES FROM FIELD SURVEY, JUNE 2018.....	109

LIST OF TABLES

Table 4.1: Level of formal education.....	49
Table 4.2: Location of Respondents	50
Table 4.3: Age and Household Size across Location	51
Table 4.4: Awareness of climate change	52
Table 4.5: Receipt of Information by Location	53
Table 4.6: Institution/Source to seek information.....	53
Table 4.7: Effects of Climate Variability on Livelihood	54
Table 4.8: Climate Variability and Vulnerability	56
Table 4.9: Crop performance in the presence of climate variability.....	57
Table 4.10: Respondents Opinion on the Cause of Crop Performance	58
Table 4.11: Climate Vulnerability and Location	60
Table 4.12: Rural-Urban Linkage.....	61
Table 4.13: Urban – Rural Linkages.....	62
Table 4.14: Satisfaction with Current Location.....	63
Table 4.15: Shared Resources among hinterlands and city dwellers.....	64
Table 4.16: How resources are shared between the city and hinterlands	64
Table 4.17: Reasons and direction of migration	68
Table 4.18: Relocation Decision.....	69

LIST OF FIGURES

Figure 2.1: Conceptual Framework	35
Figure 3.2: Map of Wa Municipality and the hinterland that make up the Study Region.....	39
Figure 3.3: Top-down and Bottom-up Approach to Climate Change	47
Figure 4.4: Migration of households in the past ten years	65
Figure 4.5: Direction of migration	66
Figure 4.6: Reason for the movement.....	67
Figure 4.7: An interaction with the Programs Officer of the EPA	72
Figure 4.8: A Focused group Session with Women at Chansa.....	73
Figure 4.9: A Focused group Session with Women at Nyagli.....	74

LIST OF ACRONYMS AND ABBREVIATIONS

BMDA	Barind Multipurpose Development Agency
DFID	Department for International Development
EPA	Environmental Protection Agency
FSC	Forest Services Commission
FGD	Focus Group Discussion
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GSGDA	Ghana Shared Growth and Development Agenda
GPRS	Ghana Poverty Reduction Strategy
GSS	Ghana Statistical Service
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GAWU	Ghana Agricultural Workers Union
GLCAs	Global Climate Action Summit
IGGS	Institute of Green Growth Solutions
ISD	Information Service Department
ILG	Institute of Local Government
MADU	Municipal Agricultural Development Unit
MEFCC	Ministry of Environment Forests and Climate Change
MoFA	Ministry of Food and Agriculture
NAPAs	National Adaptation Program of Action
NCCP	National Climate Change Policy of Ghana
NGOs	Non-Governmental Organizations
PDD	Platform on Disaster Placement
SARI	Savannah Agricultural Research Institute
SAFE	Safe Access to Fuel
SFDRR	Sendai Framework for Disaster Risk Reduction
SPSS	Statistical Package for Social Scientist
TCPD	Town and Country Planning Department
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
UNCCD	United Nations Convention to Combat Desertification
UN-SDGs	United Nations Sustainable Development Goals
WRR	World Risk Report
WB	World Bank

CHAPTER ONE

GENERAL INTRODUCTION

1.1 Background

Climate variability is now a global threat. The impact is now pervasive and, in some cases, irreversible (Jones, 2018). Developing countries have become the most vulnerable with estimates indicating that they would have to shoulder closed to eighty percent of the cost of climate change. Further analysis show that a minimum rise of 2°C in global warming, the minimum that is likely to occur, could lead to five percent perpetual and everlasting reduction in Gross Domestic Production in Africa and South Asia. This would be mainly in the area of Agriculture (World Bank, 2010).

Inherent in Sub-Saharan Africa is the fact that, the region's economies are already weak. With two-thirds of its land area, being desert and highly prone to hazards. The region's economies are based mainly on natural resources with close to eighty percent of basic energy requirements sought on biomass. About a quarter of the region's GDP is supported by agriculture that is rain fed with little or no technology and mechanization. Seventy percent of inhabitants are employed in the agriculture sector (FAO, 2012). Adaptation efforts within the region are aggravated by inadequate and poor infrastructure (World Bank, 2010).

Internal migration induced by climate variability and particularly in communities with weak systems has become the new challenge in recent times. Communities dependent on rain-fed agriculture, with poor infrastructure, where migration becomes the only adaptation measure against risk of livelihood security could be the hardest hit. It is estimated that, climate change and related impact could compel about 143 million people to migrate internally by 2050. This is expected to happen in Sub-Saharan Africa, South Asia and Latin America (Rigaud *et al.*, 2018). The urban population of Africa is growing at an alarming rate of 3.2 percent per year, the highest globally and in recent times. There has not been a corresponding development of infrastructure and related services to accommodate the teeming numbers. The demand for housing, water and other services that are inadequate or not available make urban planning and management more

complex. This increases the levels of vulnerability, with poorer households the most affected (Wisner *et al.*, 2015).

About half of the world's population still resides in rural settings. In developing and emerging economies, about 70% of their populace is rural (Todaro & Smith, 2009). There has been a growing trend of rural-urban interactions globally in recent times. This, therefore, makes rural settings an important spatial entity in evaluating the impact of climate variability. A large proportion of these rural dwellers are smallholder farmers, with high poverty rates. Studies however shows that high dependency on subsistence farming, extreme poverty rates in rural areas are decreasing worldwide through rural-urban interactions, which is fueled by migration, globalization, resources, labor, trade, and communication (Dasgupta, Partha & Morton, 2014).

The reliance on agriculture and natural resources by rural inhabitants and those within peri-urban communities make them clearly vulnerable to climate variability. The Geographic location of most rural communities coupled with low level of education, poverty, and inadequate policy makes them vulnerable to the least climate variability (Dasgupta, Partha; Morton, 2014). Development efforts aimed at reducing poverty, disease and hunger are being hampered by the consequences of climate variability. This means that resources meant for development are now being drawn into climate change issues. This represents one of the biggest challenges in contemporary times. If these competing demands are not managed properly, the gains and progress that have already been made during the erstwhile Millennium Development Goals could be unsustainable, and the current Sustainable Development Goals would continue to be a mirage especially in Sub-Saharan Africa (World Bank, 2010).

The consequences of climate variability would result out of proportion across the different regions of the world. Developing countries would bear the highest impact, even though they may contribute relatively smaller proportions to global warming. This is due to high levels of vulnerability, exposure and weak adaptation efforts (Lange, Wodon, & Carey, 2018). In the past households and their communities use to be in charge of managing the vulnerability and adaptation efforts using their indigenous knowledge. With the increase in vulnerability and its related consequences, several measures are being considered by policymakers and development practitioners to address the issue. However, studies have shown that, indigenous knowledge of

households and the communities is still relevant in the fight to reduce vulnerability to climate change and build resilient communities (World Bank, 2010).

A report compiled by Rigaud establish the findings that, about three percent of populations within Sub-Sahara, South-East Asia, and Latin America would be forced to move in and within their countries for better conditions as a coping strategy from areas that are less productive to better areas (Rigaud et al, 2018). The report further finds that, poor communities within these developing regions where infrastructure and basic amenities are insufficient and, in some cases, non-existent would experience the highest impact.

The Wa Municipality is within the North Western part of Ghana, located within latitudes 1°40'N to 2°45'N and longitudes 9°32'W to 10°20'W. The area is characterized by the North-Eastern Trade winds from the Sahara Desert that bring a long dry season between November and March. As a result, the mean annual rainfall varies between 840mm and 1400mm (Ghana Statistical Service, 2014). The region has unfavourable climatic conditions such as high temperatures that pose as threat to households' livelihoods (Abbam *et al.*, 2018; UNDP, 2011). Agricultural production is largely practiced in the hinterlands but finds market in the city (GSS, 2014). Besides, Peprah (2014) revealed that there is an emerging social and economic urban sprawl for peripheral communities of Wa. Standturf *et al.* (2011) further maintain that social vulnerability of the Upper West Region (where Wa city is located) to climate change is more intense in rural areas where over 90% of the households derive their livelihoods from agriculture.

The study region has a population of about 125,816 (GSS, 2014). The city is growing at a very fast pace into a highly urbanized town. This is characteristic of the urbanization trend currently being observed in developing countries and particularly in West Africa. Several communities surround it. Some are within the Municipality, others are outside the Municipality, nonetheless, they all have a connection with the city in terms of trade, family, shared resources and livelihood. The communities are Sing, Jonga, Cheringo, Konjiahi, Jang, Charia, Chansa, Dandafuri, Danko, Bamahu, Tabiasi, Dinaso, Dobile, Kperisi, Nyagli, Loho, Jingu, Nakore, and Siroo.

1.1 Problem Statement

Climate change effects have placed cities at risk of being increasingly hit by both natural and social dynamics such as extreme weather phenomenon and population displacement (Salvia et al., 2018). This necessitated city governments' and policy actors to identify and apply strategies that take into account both present and future impacts of climate change (Jones, 2018). The preparedness of cities to the effect of climate change gives rise to the allocation of finances to most critical areas of human life (Follador *et al.*, 2018). In the developing world, climate change financing often competes with other development objectives (World Bank, 2010) and this compels most vulnerable households to rely on indigenous systems of adaptation. Among the various responses to climate change effects in these regions is internal migration (Rigaud *et al.*, 2018).

The WorldRiskIndex ranked Ghana as high with a vulnerability of 51.54 to 63.09 (Welle, & Birkmann, 2015). This posed as a threat for the country's development. Agriculture still remains the bedrock of the country's economy, which may be worst affected by climate change. This also represents a huge setback in Ghana's quest for development. Especially, if the country is to make any progress towards attaining the targets of goal thirteen of the UN-SDGs. Scientific communities and some schools of thought have resolved that efforts meant to advance disaster-resilient communities need to be refocused with a radical change in thinking towards the inclusion and assessment of vulnerability at firsthand (Birkmann, 2013). Rigard *et al.* (2018) further indicate that regions with extreme vulnerability will experience high out-migration, and this creates fears that some parts of Ghana that have been characterized by severe climatic conditions will choose migration as an adaptive strategy.

Households in the Wa Municipality respond to climate change risks in a number of ways. Rural farmers' responds include outmigration to cities in search of alternative livelihoods to earn remittances for their families (Standturf *et al.*, 2011). On the other hand, urban dwellers also respond through sand winning and other unhealthy environmental practices, which leads to encroachment on hitherto rural and agricultural lands (Peprah, 2013). This however, brings imminent threat on food security for both rural and urban dwellers. Little is known on this aspect of rural-urban interaction in response to climate change impacts in the study region and this makes

it imperative for investigation. As a result, it is not certain, and highly unclear, whether those affected, and at risk of their own actions, are even aware of the consequences.

Education and awareness of the impact of climate change is less felt in the town and surrounding communities. There is less appreciation of information regarding climate change activities. There are very few institutions and organizations involved in climate change activities within the region. Climate change is given less attention in the medium-term development planning activities of public authorities. More trees are being cleared than are planted. The town and its neighboring communities are not prone to earthquakes by virtue of their location. However, adverse weather conditions are becoming rampant.

According to the Institute of Green Growth Solutions (2015), strong preparedness at the national level has been evident through the establishment of institutions to mitigate the harmful effects of climate change. The government's resolve to mainstream climate change into development agenda is demonstrated through the Ghana Shared Growth and Development Agenda I & II (GSGDA 2010-2017). In July 2014, the Government of Ghana launched the National Climate Change Policy (NCCP) to provide clearly defined pathways for dealing with the challenges of climate change and to identify the opportunities and benefits of a green economy. Institutional arrangements in support of these efforts include the enhancement of the local governance systems, the Environmental Protection Agency, the Ministry of Food and Agriculture, the Ministry of Lands and Natural Resources among others (Institute of Green Growth Solutions, 2015). However, the efforts of these institutions on boosting resilience to climate change in the hinterlands are questionable in the event of rising climate risks.

The city authorities have focused their energy and resources on spatial organization, land use management, the demographics, and providing infrastructure. A lot more of the citizenry are gradually getting education and becoming more discerning than ever before. However, little is known about the various interactions between the hinterland and the city, and how these interactions affect their livelihoods and make them vulnerable to the least variability in climate. There are many resources in the study region. These are land resources, water resources, vegetative cover, fertile soil, and adequate daylight. The inhabitants have been exploiting these resources for

their livelihood, which is mainly agrarian. The manner in which these resources are managed to sustain their livelihood raises several questions.

Rainfall patterns have changed and become more erratic in recent years. Farming activities in the town and surrounding communities have changed significantly in terms of crop yield. The agriculture sector is now less attractive. The deterioration of housing in the town as well as the peri-urban communities, is now rapid. Water bodies within the settlements either have less water or overflowed their boundaries.

Dasgupta revealed in a study that, the agricultural sector would more likely experience the highest shock and distress resulting from climate change. This would happen mostly in rural communities found in developing countries (Dasgupta et al, 2014). This is eminent where agriculture remains the main source of livelihood for inhabitants. The inhabitants in the hinterland, within the study region are mostly smallholder farmers, largely involved in subsistence farming. They have less or no access to technology and mechanization. They are mostly into rain-fed agriculture.

The city's capacity to anticipate and appreciate the immediate effects and impacts of climate change has not been empirically examined. There is generally less research and study about the subject in the city. Information and awareness on climate change are relatively grey in the city. Poverty is relatively high in the town. A significant proportion of the population has no formal education. The region's capacity to adopt long-term strategies aimed at sustaining the livelihood of inhabitants is in doubt.

Family ties and relations are still dominant, particularly within the hinterland. The family as an institution within their existence largely influence and play a key role in internal migration between the city and the hinterland. A large proportion of rural dwellers have family members or some form of relations within the city. This implies that, a little threat to their livelihood would cause them to migrate to the city. The extent to which family and relations affect internal migration within the region would also be determined by the study. The manner and extent to which the surrounding communities are responding to climate variability is not known. How the hinterland would reorient to sustain their livelihoods and complete living is unknown. How drought, change

in the rainfall pattern, loss in soil fertility, decline in crop yield, land degradation and diminishing water resources would influence their behavior and lifestyle is unknown. The country as a whole is still nurturing institutions to be strong and independent. The municipality and other public institutions within the study location are still weak and under-resourced. The capacity of these institutions and the existing systems to respond to climate change and its impact is not known. They are highly constraint by resources, regulation and political interference.

The study sets to investigate the above issue by assessing the level of vulnerability and climate change risk at the local level, determining how rural-urban linkages influence vulnerability and livelihood security, and finding answers to how climate variability influences internal migration at the local level. The study would contribute to knowledge and science by assessing the level of vulnerability and risk in the region focusing on rural-urban interactions.

1.2 Research Questions

These are the three overarching questions, that form the basis, and which shaped the focus of the study.

- How to assess vulnerability and climate change risk at the local level?
- How do urban-rural linkages influence vulnerability and livelihood security?
- How is migration influenced by climate variability within the Wa city region?

The Specific Research Questions are:

1. What is the current state of awareness of climate change impact in the city region?
2. What is the relationship that exist between poverty and vulnerability in the region?
3. What is the connection between education and vulnerability to climate variability?
4. What is being done to improve resilience and reduce degradation of the environment?
5. What is the impact of climate change on rural-urban linkages in the city region?

1.3 Research Objectives

The main objectives that the study sets to achieve are:

- To assess the level of vulnerability and climate change risk at the local level
- To ascertain how vulnerability and livelihood security are influenced by urban-rural linkages
- To determine how climate variability influences internal migration at the local level

The specific objectives are:

1. To ascertain the current state of awareness of climate change impact in the city region.
2. To establish the relationship that exist between poverty and vulnerability.
3. To establish the connection between education and vulnerability to climate variability within the study region.
4. To assess the measures in place through institutional governance to boost resilience and adaptive capacity.
5. To ascertain the impact of climate change on rural-urban linkages within the study region.
6. To make policy recommendations.

1.4 Relevance of the Study

There is a deficiency in literature about the above subject within the area. The study would therefore, contribute to existing knowledge by establishing the linkages that currently exist between the hinterland and the Wa city. How this relationship is influenced by climate variability in terms of rising temperature, drought, change in rainfall pattern, declining crop yield and loss in environmental quality. The complexities that characterized the rural-urban linkages would be analyzed to establish the real impact of climate change on existing systems.

The study would bring to light how livelihood security and their sustenance is influenced by climate variability and how they are adapting to this reality. How institutional weakness and failure of existing systems are contributing to vulnerability within the study region would be made known. The city and the hinterland have shared resources-water, land, vegetative cover. The manner in which the utilization of these resources is contributing to internal migration within the study region would be established. How climate variability is fueling these relationships and leading to internal migration would be found out.

Internal migration is a development issue within the study region. However, it could be a positive phenomenon depending on how authorities carry out development planning. The municipality and other public authorities of the study region prepares medium-term development plans every four years under the guidance and supervision of the National Development Planning Commission. How climate-related issues are incorporated into these plans is unclear

How poverty, in terms of inadequate education and information is contributing to climate-related migration is to a large extent grey within the study region. The study would serve as a means of creating awareness among the various households that would be interviewed. The study would therefore go a long way in educating them about their roles in combatting climate change. It would also open a world of information on how they could modify their livelihoods in the form of building resilience and adapting to climate variability.

This study would contribute to community development through the adopted methodology in that, it is participatory, household-based and would practically establish individual and household vulnerability to climate change in terms of threat to livelihoods. Goal 11 and 13 of the UN-SDGs enjoins countries to build sustainable and resilient communities and take urgent action to combat climate change and its impact. Knowledge of local systems and rural-urban interactions would provide adequate and relevant data. This would help planning authorities make informed decisions with regards to development planning.

By investigating this subject, the author would involve households from both the city and the hinterland. Mixed approach would be adopted through the study, to provide a better grasp of the variables that play in the rural-urban interactions. Development practitioners and policy-makers could better develop projects and programs that are tailored towards the needs of rural communities and the urban dwellers in the midst of climate change reality. Further research could also be carried out based on the understanding that would be established (Creswell, 2012).

Farming still remains the main source of livelihood for inhabitants within the hinterland. How this is affected by the rural-urban linkages is unknown. The provision of infrastructure and other social services affects the rural-urban linkages and how this serves as a push and/or pull factor would be established. Indigenous knowledge and local systems would be employed in assessing the level of vulnerability and risk, and how these communities are adjusting to sustain their livelihoods. The study would therefore, increase knowledge and understanding in these areas. The author would make policy recommendations at the end. This would go a long way to influence development planning at the local level.

1.5 Scope of the Study

1.5.1 Geographic Scope

The study was conducted within the Wa Municipality and its surrounding communities (hinterland) that together forms a region for the purposes of this study. The communities within the hinterland were Sing, Jonga, Cheringo, Konjiahi, Jang, Charia, Chansa, Dandafuri, Danko, Bamahu, Tabiasi, Dinaso, Dobile, Kperisi, Nyagli, Loho, Jingu, Nakore, and Siroo.

1.5.2 Contextual Scope

The study evaluates vulnerability and climate change risk at the Wa city region and further assessed how vulnerability and livelihood security are influenced by urban-rural interactions. The study further looks at the phenomenon of internal migration at the local level, and how this is influenced by climate variability within the study area.

1.7 Limitations of the Study

The chosen methodology was limited and highly constraint by the period for completing a thesis in the University of Stuttgart and also the resources of the author. However, I was committed to attaining the purpose of the study.

1.8 Organization of the Report

The study is logically organized into five chapters. Chapter one gives a background of the study. This puts the study into proper perspective. The chapter also has, as part of its content, the statement of the problem and further outlines the research questions and objectives that drive the study.

Chapter two introduces an extensive review of related literature. This is composed of concepts related to the subject, theory and framework. Chapter three presents a concise definition of the methodology adopted throughout the study. It outlines the study region, the research design, the target population, sampling procedure and arrangements, and how the data is sourced and analyzed.

Chapter four presents the results and discussions under the various research questions. It also contains implications drawn from the findings. Chapter five carries a general discussion of the findings, summaries the findings of the study, vis-à-vis the research questions, draws conclusion and makes recommendations, where necessary, to appropriate authorities.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of literature related to climate change and migration with much focus on the rural-urban linkages. The first section presents a conceptual review. The main concepts reviewed include climate variability, climate risk, vulnerability resulting from climate change, migration, and the concept of resilience. The chapter also contains a theoretical review followed by an empirical review. The empirical review of literature focused mainly on the objectives under investigation. The literature review also discusses the conceptual framework of the study.

2.2 Conceptual Review

2.2.1 Climate Variability

Climate variability is a concept discussed extensively by both past and recent studies in different geographic locations all over the world. The term has long been used synonymously as climate change and is described as seasonal changes, inter-annual variability and the likely frequency of weather-related extreme events (DFID, 2004). This variability is often an ongoing stress within people's lives. Brooks *et al.* (2014) maintain that, climate hazards may be sudden onset (e.g. storms) or slow onset (e.g. droughts), recurrent (e.g. most weather extremes) or 'singular' (e.g. glacial lake outbursts) or transient (weather extremes) or effectively permanent (e.g. sea-level rise, long-term increases in aridity). This means that climate variability may take different forms depending on the climatic conditions of that particular place. People will therefore consider climate within their livelihood activities and other risks that they face (DFID, 2004).

The World Bank (2010) reported that today's enormous development challenges are complicated by the reality of climate change. Climate change according to the Institute of Local Government (ILG) is any significant changes in measure of climate (temperature, precipitation or wind) lasting for an extended period (decades or longer) (ILG, 2010). By the end of the 21st century, meteorological droughts (less rainfall) and agricultural droughts (drier soil) are projected to become longer, or more frequent, or both, in some regions and some seasons, because of reduced

rainfall or increased evaporation or both hence leading to climate variability (Jimenez Cisneros, *et al.*, 2014).

Additionally, climate change is projected to alter the frequency and magnitude of both floods and droughts. The impact is expected to vary from region to region. The few available studies suggest that flood hazards will increase over more than half of the globe, in particular in central and eastern Siberia, parts of Southeast Asia including India, tropical Africa, and Northern South America, but decreases are projected in parts of Northern and Eastern Europe, Anatolia, central and East Asia, central North America, and southern South America (Jimenez Cisneros, *et al.*, 2014).

The frequency of floods in small river basins is very likely to increase, but that may not be true of larger watersheds because intense rain is usually confined to areas that are more limited. Spring snowmelt floods are likely to become smaller, both because less winter precipitation will fall as snow and because more snow will melt during thaws over the course of the entire winter. Worldwide, the damage from floods will increase because more people and more assets will be affected. (Jimenez Cisneros *et al.*, 2014).

The key results of climate change in Ghana are drought and floods. Because of its geographical location the impact is severe in the Northern part of the country (Kudjey, 2014). In its report on human development in the Upper West Region, UNDP (2011) indicated that, the climate is typical of the tropical continental regime occurring in the Northern savannah of Ghana, with one rainy season from May–October and that the average annual rainfall at Wa, the Municipal Capital, is 1027 mm. Mean annual relative humidity is 50–60 per cent with mean relative humidity of the driest month at less than 30%. A study conducted by Rademacher-Schulz and Mahama (2010) in the Nadowli District in the Upper West Region, proved that, local livelihoods have experienced the negative effects of changing rainfall pattern. The study revealed several changes in rainfall patterns over the past 20 to 30 years. The results further indicate that an increase in heavy rainfall causing floods, a delay of the rainy season, an increase of the occurrence of dry spells and more heat.

Besides, climate variability is manifested in changes in temperature. One possible consequence of atmospheric change is global warming when the dumping of additional quantities of greenhouse gases into the atmosphere increase its heat retention (Williams, 2000). Porter *et al.* (2014) reveal in their work that global temperature increased by 4°C or more above the late-20th-century.

Averagely, temperatures are increasing and both longer dry spells and heavy rainfall events are increasing in frequency during planting season (Rademacher-Schulz & Mahama, 2010). This may be as a result of natural factors such as: change in sun's intensity or slow change in the earth's orbits around the sun; natural processes with the climate system (such as change in the ocean circulation) and human activities that change the atmospheric composition (such as burning fossil fuel) and the land surface (such as deforestation, reforestation, urbanization or desertification. The impacts of a changing climate (temperature) are already being felt, with more droughts, more floods, more strong storms, and more heat waves taxing individuals, firms, and governments, drawing resources away from development (World Bank, 2010).

In terms of causes of climate variability and climate change in the study area, a recent study by Appiah *et al.* (2018) reported that the removal of vegetation has increased the changes in climatic conditions in the country. In the Upper West Region of Ghana, temperatures are high mostly throughout the year. Low temperatures, however, are experienced between November and February during the Harmattan period. Statistically, the mean annual temperatures in the region are around 27–28 °C (UNDP, 2010). If this continuous, human security will be progressively threatened (Adger *et al.*, 2014).

2.2.2 Climate risk

Risk comprises exposure to natural hazards and vulnerability of a society (World Risk Report, 2014). Climate change will increase the frequency, severity, and likelihood of many of these hazards, which will interact with non-climate hazards to affect people's well-being, the extent of losses and damages from climate-related phenomena, and the extent to which development interventions can deliver and secure desired gains in human well-being (Brooks *et al.* 2014). Today, we are emitting greenhouse gases that trap heat in the atmosphere for decades or even centuries. We are equally, building power plants, reservoirs, houses, transport systems, and cities that are likely to last 50 years or more.

The innovative technologies and crop varieties that we pilot today can shape energy and food sources to meet the needs of 3 billion more people by 2050 (World Bank, 2010). Situations of acute insecurity, such as famine, conflict, and sociopolitical instability, usually emerge from the interaction of multiple factors. Changes in climate may influence some or all of the factors at the same time (Dasgupta, et al. 2014; Adger *et al.* 2014). However, the probability of some of these events occurring is not often known thus posing risk to human life. For many populations that are

already socially marginalized, resource dependent, and have limited capital assets, human security will be progressively undermined as the climate changes. Observed impacts of weather events and climate on livelihoods and poverty and impacts projected from the subnational to the global level suggest that livelihood well-being, poverty alleviation, and development are already undermined and will continue to be eroded into the future hence making people more vulnerable (Olsson *et al.* 2014).

Human populations already experience a variety of climate hazards, which can be defined as physical manifestations of climate variability and change with the potential to have negative effects on the environment and on society. Examples of climate hazards are meteorological droughts (i.e. defined in terms of rainfall deficits below a particular threshold, usually the long-term mean), episodes of intense rainfall that might result in flooding or crop damage, tropical storms, and longer-term change such as sea-level rise or changes in average or extreme temperature or rainfall (Brooks *et al.*, 2014).

Rural areas in developing countries in particular are characterized by dependence on agriculture and natural resources; high prevalence of poverty, isolation, and marginality; neglect by policymakers; and lower human development (Dasgupta, *et al.*, 2014). One billion people lack clean drinking water; 1.6 billion, electricity; and 3 billion, adequate sanitation and still live on less than \$1.25 a day. A quarter of all developing country children are malnourished (World Bank, 2010). Despite all these challenges, yet climate change threatens all countries, with these developing countries the most vulnerable. Estimates are that, they would bear some 75 to 80 percent of the costs of damages caused by the changing climate. This is because most developing countries lack sufficient financial and technical capacities to manage increasing climate risk. They also depend more directly on climate-sensitive natural resources for income and wellbeing. In addition, most are in tropical and subtropical regions already subject to highly variable climate (World Bank, 2010; Dasgupta, et al. 2014).

2.2.3 Climate vulnerability

Vulnerability is defined as the propensity to be affected by climate change, related to underlying socio-economic, demographic, political and cultural processes and conditions (Campbell *et al.*, 2016). It is an indication of people's exposure to external risks, shocks and stress and their ability to cope with, and recover from the resulting impact (DFID, 2004). This study further maintains that vulnerability may differ seasonally or at different times within people's lives. Jorstad and

Webersik (2016) described some rural households in Malawi as vulnerable to climate change because of their lack of capacity to manage the adverse effect of the risk associated with climate variability. They point out that such vulnerable people tend to be poor, and dependent on climate sensitive resources for their livelihood. Gentle and Maraseni (2012) explain that communities that struggle to adapt to their changing environment with their limited knowledge, poor assets and inadequate external support are often vulnerable. This suggests that vulnerability has a connotation with the inability for a person to mobilize enough assets against the climate risk. Huq *et al.* (2015) therefore, conclude that vulnerability profile of communities is a combination of their physical exposure to climatic events, their fragile economic conditions, their depleting resource base, and the inability of institutional support to mitigate their changed or worse conditions.

Vulnerability according to World Risk Report (2014) is the component of susceptibility, lack of coping strategies and lack of adaptive capacities. The level of vulnerability is correlated with factors such as the risk of exposure to shocks, the level of poverty, the social structure, the diversification of assets and income and the political situation (Mbaye, 2017). All developing regions are vulnerable to the impact of climate change (World Bank, 2010). However, research have shown that developing countries especially African countries are hard hit. For instance, Birkmann and Welle (2016) indicated in their findings that countries with highest vulnerability are primarily located on the African continent. In their analysis of countries with the highest vulnerability scores, they revealed that the Sahel countries, such as Chad, Niger, Sudan, Mali and Mauritania all face significant challenges regarding susceptibility as well as coping and adaptive capacities. This is in line with Dav (2011) argument, that livelihoods are more vulnerable in mountainous areas like Himalayas, arid and semi-arid areas like Pakistan and India, vast coastal areas in South East Asia and pacific islands and forest areas. These countries are not only characterized by a high level of persistent poverty but also by significant governance failures and corruption problems (Birkmann & Welle, 2016). This means that the lack of capacity to manage the risk associated with climate variability can lead to vulnerability.

Observed evidence suggests that climate change and climate variability worsen existing poverty, exacerbate inequalities, and trigger both new vulnerabilities and some opportunities for individuals and communities (Rigaud, *et al.*, 2018; Olsson *et al.*, 2014). Even modest changes in seasonality

of rainfall, temperature, and wind patterns can push transient poor and marginalized people into chronic poverty as they lack access to credit, climate forecasts, insurance, government support, and effective response options, such as diversifying their assets. Such shifts have been observed among climate-sensitive livelihoods in high mountain environments, dry lands, and the Arctic, and in informal settlements and urban slums (Olsson *et al.*, 2014). Furthermore, the distinctive characteristics of rural areas make them uniquely vulnerable to the impacts of climate change because: greater dependence on agriculture and natural resources makes them highly sensitive to climate variability, extreme climate events, and climate change and existing vulnerabilities caused by poverty, lower levels of education, isolation, and neglect by policymakers (Dasgupta, 2014). When this happens, they turned to search for alternative ways of managing their situation. Likely, migration can be a sensible climate change adaptation strategy for these people (Rigaud, *et al.*, 2018).

2.2.4 Migration

Migration is the process of moving within or across borders, either temporarily, seasonally or permanently. Migration is commonly associated with an element of choice, and in this study, it is considered voluntary in nature. On the other hand, in instances where there is no choice but to move, either temporarily or permanently, within or across borders then it is term as displacement (Stapleton *et al.* 2017; Adger *et al.*, 2014). In this study, both are referred to as the movement of people from their place of residence because of climate change such as flood and drought, among others. In recent times, cross border migration and its implications for host countries have captured high-profile global attention (Rigaud, *et al.* 2018; FAO, 2017). FAO (2017) revealed that climate change impact on migration is through increases in the frequency and intensity of weather and climate risks. These climate-related risks can be sudden-onset events (e.g. tropical storms, heavy rains, floods and droughts) or slow-onset ones (e.g. sea-level rise, salinization and desertification). Along similar line, population movement is a natural way to deal with climatic shocks, particularly when livelihoods are destroyed.

Migration can be considered as an adaptation strategy when disasters occur because it helps mitigate the adverse effects of climatic shocks by providing new opportunities and resources to affected people. It is also employed as a coping strategy when other solutions have failed (Mbaye, 2017). In recent times, migration has become a sensible climate change adaptation strategy,

especially when managed carefully (Rigaud, *et al.*, 2018). Safe, orderly and regular migration can contribute to agriculture development, economic growth, food security and rural livelihoods (FAO, 2017). Migration according to Tacoli (2011) is an adaptive response to socio-economic and environmental transformation. Research have proven that environmental conditions such as climate change in rural areas will amplify migration to urban centers (Adger *et al.*, 2014). Major extreme weather events have in the past led to significant temporary population displacement, and changes in the incidence of extreme events will amplify the challenges and risks of such displacement. There are no robust global estimates of future displacement, however, what we know is that in 2016, over 24 million people were newly displaced by sudden onset of climate related hazards, such as typhoons and floods (Stapleton *et al.*, 2017).

There is significant evidence that, planning and increased mobility can reduce the human security costs of displacement from extreme weather events. There is increasing recognition that far more people are migrating within their own countries than across borders. They move for many reasons-economic, social, political, and environmental. Now, climate change has emerged as a potent driver of internal migration, propelling increasing numbers of people to move from vulnerable to more viable areas of their countries to build new lives (Rigaud *et al.*, 2018). Poorly managed migration can increase vulnerability to climate risks, heighten pressure on scarce natural resources, and exacerbate tensions between migrants and host communities on land tenure and resource rights (FAO, 2017).

2.2.5 Resilience to Climate Change

Regardless of the efforts put into mitigation, some impacts of climate change are already unavoidable. Adaptation to climate change has therefore become a key component of domestic climate policy, along with mitigation (Klein, *et al.*, 2008). To this effect, the economies and people of many developing countries depend on ecosystem services. The capacity to mitigate and adapt to these ecosystems is contingent on their resilience (GLCA, 2009). According to Compbell *et al.* (2016), resilience is the ability of a community or system to absorb shocks. Building resilience to extreme weather and climate events means finding better ways to adapt to climate change. Resilience in some circles, is also viewed as the ability of a natural, social, or coupled social-ecological system to withstand shocks and rebuild itself when necessary. FAO (2017) indicated that migration could increase the resilience of vulnerable populations, especially in climate-

sensitive rural areas. Besides, migration is related to improved resilience and remittances (Campbell, 2016). Migrants can help create decent employment and inclusive social protection systems by transferring remittances, technology, knowledge and skills (FAO, 2017). The success of adaptation relies on the success of development, and vice versa. Poverty reduction, good governance, education, environmental protection, health and gender equality all contribute to adaptive capacity (Klein *et al.*, 2008).

2.3 Theoretical Review

The writings of Kohn (2014) on vulnerability theory indicate that vulnerability is inherent to human condition and that government has a responsibility to respond affirmatively to societal instruction. Marher Fineman's vulnerability theory is emerging as an influential and powerful new critique of formal equality as an alternative framework for understanding substantive equality. Fineman postulates that all human beings are vulnerable and prone to dependency. The state has a corresponding obligation to reduce and compensate for vulnerability. What is expected from the state is to provide enabling environment for equal access to resources. This according to Fineman is the original obligation of the state to respond to vulnerability. This argument is based on the premise that, it is the state that has legitimate and given power to social institutions that increase resilience for some while undermining the resilience of others.

According to Rich (2018), vulnerability theory is an emerging legal theory that argues for a larger, more active state. Fineman paints a picture of humans as universally and constantly vulnerable, heavily impacted by societal institutions giving (or not) them, the resources allowing them to fend for themselves. Fineman therefore, advised that governments should transfer decision-making power to groups of people considered more vulnerable. This position reflects what recent proponents of climate change discourse are advocating for-bottom up approaches.

According to Rich (2018), the explanation of vulnerability theory is divided into five components:

- The rejection of the liberal theory in favor of a vulnerable subject
- The universality and constancy of vulnerability
- The role institutions can play in mitigating vulnerability
- Movement from formal equality to substantive equality

- The state should play a larger and more active role on the lives of individuals

Fineman's theory will have practical application in the analysis of vulnerability in the age of climate variability. This is more relevant when states recognize the role of vulnerable people and hence take steps to boost resilience. In third world countries such as Ghana, the government has adopted a decentralized system of governance that delegates the power of decision making to sub-governmental units. This arrangement recognizes vulnerable groups and hence the movement towards substantial equality. Despite these efforts, Fineman still argues that, the state should be more responsible and concern with the lives of individuals. In the Wa City Region, state established institutions such as the Regional/Municipal Agricultural Development Unit, the Forestry Service Department, the Environmental Protection Agency and the Town and Country Planning Department have been mandated with the responsibility of boosting resilience to climate change impact and other related hazards. This, they could carry out directly or indirectly, advertently or inadvertently. Hence, Fineman's theory of vulnerability will be adopted and applied in this study with much focus on rural-urban linkages, and how the state intervenes in the mitigation and adaptation of climate change.

2.4 Empirical Review

2.4.1 Vulnerability and climate change risk

Climate change is considered one of the most serious threats to sustainable development globally. Studies have shown that 90% of all-natural disasters afflicting the world are related to severe weather and extreme climate events. Impacts of climate change are expected in many key sectors such as environment, human health, food security, natural resources and physical infrastructure (Republic of Ghana, 2015; Hossain & Rahman, 2012). As the planet warms, rainfall patterns shift, and extreme events are frequent. Millions of people often lose their homes and poor people face prospects of tragic crop failure, reduce agriculture productivity and increase in hunger and malnutrition (World Bank, 2010). The livelihood and income of a large population depends on the natural resource base and most of the poor people often live in marginalized lands and areas more prone to natural disasters. Climate change means that many natural disaster-prone areas will become more prone due to increased frequency and intensity of disasters (Hossain & Rahman, 2012). What we need to know is that poor people are poor for different reasons and thus are not

all equally affected and not all vulnerable people are poor. However, climate change-driven impacts are one of many important causes of poverty.

Climate change causes rural migration and intensifies other socio-economic drivers of migration, such as rural poverty and food insecurity (FAO, 2017). It is stated that the people often affected by the impact of climate change belong to the most marginalized section of the population (WRR, 2014). Climate-related hazards exacerbate other stressors, often with negative outcomes for livelihoods, especially for people living in poverty. They often act as a threat multiplier, meaning that the impacts of climate change compound other drivers of poverty leading to vulnerability. Poverty is a complex social and political problem, intertwined with processes of socio-economic, cultural, institutional, and political marginalization, inequality, and deprivation, in low middle and even high-income countries. Climate change intersects with many causes and aspects of poverty to worsen not only income poverty but also undermine well-being, urgency, and a sense of belonging (Olsson *et al.*, 2014; GLCA, 2009).

Globally, people are engaged in a broad range of livelihoods including agriculture and non-agricultural activities (Kong'ani, 2016; GAWU, 2012, GLCA, 2009). In his study on climate change, rural livelihoods and agriculture, Dev (2011) explained that rural households get livelihoods through agriculture, rural non-farm sector and migration. Agriculture is defined as the use of land for the production of food and fiber, including the growing of crops and/or the grazing of animals on natural prime or improved pastureland (ILG, 2010; Porter, et al. 2014; Kudjey, 2014). Agriculture is the largest sector of the Bangladesh economy, accounting for some 35 percent of the GDP and 63 percent of the labor force (Selvaraju, et al. 2006). More than 60 percent of Asian population is directly or indirectly relying on agriculture as a source of livelihood. Most African countries equally, depend on agriculture as source of livelihood (Kudjey, 2014). In most of the African countries, the majority of the workforce is in the agricultural sector but contributes just a little percentage to the national GDP (GAWU, 2012). However, agricultural production is already under pressure from increasing demands for food and the parallel problem of depleting land and water resources caused by overuse and contamination. Impacts of climate variability and change cause an additional risk to agriculture (GAWU, 2012; Dev, 2011; Selvaraju,

et al. 2006). Yet large amount of evidence suggests that participants in agriculture are mostly hit by the adverse effects of climate risk such as reduced yields of staple cereals (Porter et al. 2014).

Dube & Phiri, (2013) made it clear that climate-related disasters are among the main drivers of food insecurity, both in the aftermath of a disaster and in the long run. It has led to the destruction of important food supplements for local communities making them vulnerable to food insecurity. Climate Change affects all countries in the world. Droughts and floods are destroying especially the crops and harvest of farmers in developing countries, leaving them in a miserable situation. Drought-prone areas will become hotter and drier, with less predictable rainfall; flood frequency and intensity, as well as the onset and recession will be change in future; the nature of cyclone and storm surges will be different from the historical trend. All of these together will change crop yields and affect many poor people's livelihoods (Hossain & Rahman, 2012). Making most of the farmers to be living in sincere poverty, struggling with life and are often forced to accept a second or third job in order to survive (GAWU, 2012). This has led to millions of people directing their meager financial and human resources to foster adaptation to climate change that are impacting their existence (GAWU, 2012).

According to Dasgupta et al. (2014), rural areas still account for almost half the world's population, and about 70% of the developing world's poor people. Specifically, rural people in developing countries and particularly in sub-Saharan African countries are among the most vulnerable to climate change (Kudjey, 2014). They are especially vulnerable to climate change because of their ecological fragility and economic marginality, which in turn limit their adaptive capacity (Duwal, 2015).

According to FAO (2017) rural livelihoods are affected by both short- and long-term effects of climate change, because of its significant impacts on agricultural productivity. People working in the agricultural sector are particularly affected by short-term climate shocks (droughts, flooding etc.) and long-term climate change (Waldinger & Fankhauser, 2015). Climate change has altered the physical geography of areas leading to disappearance of flora and fauna and other natural habitats that contributed to the livelihoods of the local people.

The effects of climate change on crop and terrestrial food production are evident in several regions of the world (Porter et al., 2014). For example, the impact of observed changes in climate trends, variability and extreme events show that the crop yield in many countries of Asia has declined,

partly due to rising temperatures and extreme weather events. Recent studies on projections have suggested that substantial decline in cereal production potential in Asia could reduce by the end of this century due to climate change (Dev, 2011). In Dube & Phiri (2013) revelation, and if their results are anything to go by, then climate change will prove to be a disaster for the livelihoods of poor people especially in semi-arid regions in sub-Saharan Africa. In Zimbabwe, declining precipitation and rising temperatures are making farming increasingly more difficult, and thus aggravating food insecurity in the area (Dube & Phiri, 2013). Research had it that, countries such as Brunei Darussalam and Serbia risk has increased, particularly due to higher susceptibility and lower coping and adaptive capacities to deal with extreme events and natural hazards (Birkmann & Welle, 2016).

Ghana's economy largely relies on climate-sensitive sectors, in particular agriculture, energy and forestry. Agriculture is currently one of the biggest contributors to Ghana's Gross Domestic Product (GDP). Approximately 70 per cent of the population depends directly or indirectly on agriculture (fisheries, crops and livestock farming). In rural Ghana, inhabitants are restricted mainly to agriculture such as the production and distribution of foods and related services (UNDP, 2011). In the Nadowli District of the Upper West Region, rain-fed subsistence agriculture and livestock rearing are the main economic activities of the population, as the district offers little other employment opportunities and low diversification of the economy (Rademacher-Schulz & Mahama, 2010). Any climate-related disaster is, therefore, likely to affect the economy of Ghana, especially, the more vulnerable rural communities who depend largely on rain-fed agriculture and comprise the majority of the population (Republic of Ghana, 2015). Research shows that the country's climate has changed over the last years. Crops are getting destroyed due to periods of extreme heat and heavy rains (GAWU, 2012). Climate change and related variability form a continuously growing and major constraint to the development of the food and agriculture sector (including fisheries) in Ghana (Republic of Ghana, 2015).

Attributions of climate change happenings in Ghana include severe storms and floods, extreme hot weather and droughts resulting in drying up of major water bodies (Vorsah, 2015). Furthermore, the impact of climate change is mainly due to the increasing variability of rainfall resulting in recurrent and longer dry spells that delay and shorten the growing seasons. In addition, rainfall is

becoming more intense resulting in flash floods that destroy crop lands and cause land degradation due to erosion. In the area of fisheries development, increasing numbers of coastal communities continue to experience a reduction in land areas available for agriculture due to sea erosion caused by rising sea levels (Republic of Ghana, 2015). The direct impact of these climate change effects is a continuous reduction in or destruction of livelihood sources for most rural families (Republic of Ghana, 2015). The impacts of climate variability and climate change are evident among the rural smallholder farmers (Appiah et al. 2018; Kudjey, 2014).

Drought is a major driver of food insecurity, and contributes to a negative impact on nutrition. Floods and tropical storms also affect food security by destroying livelihood assets (Porter *et al.*, 2014). Highly variable annual rainfall conditions influence agricultural production significantly, leading to potential reduced yield or harvest losses and more severely to food security (Rademacher-Schulz & Mahama, 2010). Extreme events, such as floods, droughts, and heat waves, especially when occurring in a series, can significantly erode poor people's assets and further undermine their livelihoods in terms of labor productivity, housing, infrastructure, and social networks (Olsson *et al.*, 2014). As a result of these conditions, crop production faces many challenges such as post-harvest losses: and unfavorable agro-meteorological and other conditions in farming communities within the Wa Municipality, Ejura and Sekyedumasi Municipal (Vorsah, 2015; UNDP, 2011). This suggests that agriculture, food security, and nutrition are all highly sensitive to changes in rainfall associated with climate change.

Indirect impacts, such as increases in food prices due to climate-related disasters and/or policies, can also harm both rural and urban poor people, who are net buyers of food. Also, poor urban people are particularly vulnerable to food price as they use a large share of their income to purchase food (Olsson *et al.*, 2014). Continuing climate change, at current rates, pose increasingly severe challenges to development (World Bank, 2010; ILG, 2010). Climate change is expected to increase risks to businesses, infrastructure, assets and economies (Trabacchi & Mazza, 2015). The physical aspect of climate change such as sea level rise, extreme events and hydrologic disruption pose major challenges to transport, water and energy infrastructure (Adger *et al.*, 2014). This situation poses serious health risks to food production systems and many other key social and ecological functions that human civilization depends upon (Williams, 2000). Vulnerability profile of

communities in Huq *et al* (2015) work, is a combination of their physical exposure to climatic events, their fragile economic conditions; the depleting resource base, the inability of formal institutions as well as the external pressures (such as shrimp farmers from outside the areas).

That notwithstanding, manufacturing industries in these areas, the livelihoods and incomes that are based on them, will in turn be substantially affected. Infrastructure (e.g., roads, buildings, dams, and irrigation systems) will be affected by extreme events associated with climate change. According to World Bank (2010) report, there is the need to act now, because what we do today determines both the climate of tomorrow and the choices that shape our future. Climate change is a threat-multiplier to conflicts, violence and natural disasters that cause migration of agriculture dependent populations (FAO, 2017). When there is poor governance and disruption to food, water and livelihood activities, this could lead to conflict (Stapleton *et al.*, 2017). People living in places affected by violent conflict are particularly vulnerable to climate change (Adger *et al.*, 2014).

An analysis of global patterns of risk shows that not only the physical exposure to extreme events or natural phenomena but also the societal context conditions in countries like Vanuatu, Niger, Haiti and Afghanistan are key drivers of risk (Birkmann & Welle, 2016). Similarly, in times of conflict, climate-related natural disasters or complex emergencies, accessing cooking fuel may further place the lives of affected populations at risk (FAO, 2017). Climate change will therefore provide both an obligation and an opportunity to reconfigure development strategies so that they meet the needs of the present generation without compromising future generations' abilities to meet their needs (GLCA, 2009).

About education, the existing vulnerability caused by lower level of education can aggravate climate change impact in many ways (Dasgupta *et al.*, 2014). Farmer's adaptation to the changing climate is limited by several factors including lack of climate change and adaptation knowledge (Dube & Phiri, 2013). Evidence is that, better off households, which are morally made up of literates or male headed have more diversified livelihood portfolio, making them less vulnerable to climate impact (Rademacher_schulz & Mahama, 2010). Nevertheless, lay knowledge about the environment and climate is deeply rooted in history, and encompasses important aspects of human life. Lay knowledge is particularly pertinent in cultures with an intimate relationship between people and the environment (Adger *et al.*, 2014). For many indigenous and rural communities, for

example, livelihood activities such as herding, hunting, fishing, or farming are directly connected to and dependent on climate and weather conditions. These communities thus have critical knowledge about dealing with environment changes and associated societal conditions. In regions around the world, such knowledge is commonly used in adapting to environmental conditions and is directly relevant to adaptation to climate change. However, this knowledge is often neglected in decision making process, which in turned create conflict among the citizen and the policy makers (Adger *et al.*, 2014; Birkmann *et al.*, 2017). When examining educational profile of households in Nigeria, it became evident that particularly households with low level of education view the performance of risk management of governmental institutions at the local level more negative compared to those with a higher educational level and higher income. As a result, many households with low level of formal education and low income did not undertake any changes in the risk management regime Birkmann *et al.* (2017).

2.4.2 Awareness of climate change impact

Sustainable development requires that communities together with their resources are requisite to correct deteriorating infrastructural works and services (Williams, 2000). Climate change is one stressor that shape dynamics and differential livelihood trajectories. Changing in climate trends according to Olsson *et al.* (2014) leads to shifts in rural livelihoods with mixed outcomes such as from crop-based to hybrid livestock-based livelihood or wage labor in urban unemployment. Cities themselves are drivers of climate change e.g. through transport, energy consumption, industry and consumption in general. In addition, they can actively contribute to mitigating and counter the impact of climate change (World Risk Report, 2014). Their vulnerability depends on their ability to adapt to these changes, for example, with new crop varieties, as well as through nonagricultural activities, such as consumption smoothing through access to credit, insurance and social safety nets (Waldinger & Fankhauser, 2015).

Conversely, farmers had noticed, and are becoming aware of climate change and variability (Vorsah, 2015). At present, most rural communities in Ghana are becoming increasingly aware of the effects of climate change and climate variability (Republic of Ghana, 2015). As a result, they are adapting through available coping strategies to minor the impacts of climate change. Selvaraju *et al.* (2006) categorized these strategies into traditional, locally managed practices such as pond excavation, retention of rainwater in Khari canals and moisture conservation. Government-

supported practices such as deep tube well facilitated irrigation, supplemental irrigation and mini-ponds, alternative and innovative automatic adaptation practices such as adoption of mango farming, integrated crop-livestock farming systems. Also, technology driven efforts such as new short-duration and drought-tolerant crop varieties, cropping systems and homestead gardening.

In his study on climate change effects on smallholder farmers' livelihoods in the Ashanti region, Vorsah (2015) found that the most dominated coping strategy employed by the farmers was on-farm strategies and the least was the off-farm strategies. There is increasing evidence that farmers in some regions are already adapting to observed climate changes, in particular altering cultivation and sowing times and crop cultivars and species (Vorsha, 2015).

Birkmann *et al.* (2016) are of the opinion that one major trigger for change of behavior is the experience of damage due to extreme events and hazards. Rural people in many parts of the world have, over long-time scales, adapted to climate variability, or at least learned to cope with it. Local communities in Nepal have started to adapt in their own ways, such as with drought resistant crops, the diversification of occupations, and out-migration (Duwal, 2015). They have done so through traditional risk management practices such as sharecropping, goat rearing, craft and use of wild natural resources (often referred to as indigenous knowledge or by similar terms), as well as through diversification of livelihoods and through informal institutions for risk-sharing and risk management (Dasgupta *et al.*, 2014; Selvaraju *et al.*, 2006). People in the Nadowli District of Ghana have developed such coping or adaptation strategies to deal with impacts (food insecurity) of climate change. Some of such means according to Rademacher-Schulz and Mahama (2010) include the sale of livestock's, reduction of food consumption, seasonal migration and modification in crop production, namely planting other crops and early maturity varieties.

Despite having experienced changes in temperature, rainfall, available water sources, and the condition of agricultural practices, studies points out that some farmers are unaware of climate changes impact (Duwal, 2015; Dube & Phiri, 2013). In analyzing perceived impacts of climate change on forests and livelihoods in the Padampokhari Village, Duwal (2015) found that most of the people in rural communities of Nepal do not understand climate change. Dube and Phiri (2013) survey in Zimbabwe also added that most farmers were unaware of the concept of climate change. They believed that poor agricultural seasons were a local phenomenon in Matobo that could be

solved by obeying their local gods. As a result, their livelihoods strategies are disappearing with climate change.

The literature provides enough empirical evidence of local communities especially farmers awareness of climate change. As a result, they have gone ahead to adopt mitigation strategies to improve their occupations. The various emerging measures being adopted by farmers also means that they have become aware of the changing climate pattern in their environment. However, some empirical evidence suggests that some local communities are unaware of climate change impact. Such group of people have attributed the changes in climate to superstition and hence not ready to adopt strategies to improve their situation. There is however, limited empirical evidence in the Wa City Region for conclusion hence the need to examine community awareness and responds to the impact of climate change.

2.4.3 The influence of urban-rural linkages on vulnerability and livelihood security

In many countries of the third world, dependence on agriculture and natural resources, high prevalence of poverty is present in rural areas. These conditions sometimes influence rural dwellers to seek livelihoods in urban areas thus resulting in a close interdependence between rural and urban areas (Dasgupta *et al.*, 2014).

Climate change is one of the most complex challenges of our young century. Climate change cannot be solved without countries, regional and local communities cooperating on a global and community scale to improve energy efficiencies, develop and deploy clean technologies, and expand natural “sinks” to grow green by absorbing gases (World Bank, 2010). The persistence of high risk in various countries in Africa and Oceania also suggests that it is likely that these countries might not be able to effectively reduce risks solely on their own but rather need regional approaches and institutions for risk reduction and adaptation (Birkmann & Welle, 2016). Nevertheless, implantation of cooperation by these bodies depends on the action within the communities (Rural and Urban).

These actions are deeply rooted in traditions and values that have been developed and adopted by the community members for a long time, dating back in history. They could deal with different issues related to social, natural, financial or human capital (Elasha, 2006). According to Adger *et al.* (2014) study on human security in climate change, indigenous, local, and traditional forms of knowledge are a major resource for adapting to climate change. They reported that natural resource

dependent communities, including indigenous people have a long history of adapting to highly variable and changing social and ecological conditions. Elasha (2006) buttress the broadly-held view that social capital is one of the most important determinants of resilience to shocks, in this case, climate-related shocks and stress.

In Darfur for example, people believed that, they should share three things: water, range land and fire. Based on this, they allow poor people in the tribe and moving nomads, accessibility to water and pasture. Family and informal social networks, community groups, self-help groups, effective local decision-making bodies and institutions were each identified as important resources for building and preserving the capacity to cope with climate impacts. Migration and mobility are adaptation strategies in all regions of the world that experience climate variability (Adger *et al.*, 2014).

2.4.4 Climate variability and internal migration

Adger *et al.* (2014) indicated that moving from one place to another is fundamental way humans respond to challenging conditions. In the developing world, most environmental migrants are forced to flee because of loss of livelihood or habitats (Martin, 2010). Mbaye (2017) conducted a study on climate change, natural disaster and migration and came out that migration can be considered as an adaptive strategy when a disaster occurs, because it helps mitigate the adverse effect of climate shocks by providing opportunities and resources to the affected people.

Migrants choose destinations and duration based on existing networks, skill levels, credit constraints and travel costs (Walddinger & Fankhauser, 2015). Climate change will have significant impacts on forms of migration that compromise human security. Depending on the circumstances, disaster can lead to international or internal migration (Mbaye, 2017). However, there is less evidence on the relationship between climate change and international migration (Walddinger & Frankhauser, 2015). The dominant migration system in the world has been movement from rural to urban areas within countries as people seek more favorable work and living conditions (Rigaud *et al.*, 2018).

Empirical evidence shows that people in developing countries are likely to respond to climatic change by migrating internally (Walddinger & Fankhauser, 2015). Besides, Campbell *et al.* (2016) in their work on climate and migration revealed that internal migration can contribute to building the adaptive capacity to cope with climate change through income diversification and reducing the population in a particularly exposed area. Quite recently, it has been reported that internal migrants

are rapidly becoming the human face of climate change (Rigaud et al. 2018). The adaptive capacity in Nauru to cope with climate change is limited and internal migration is not a solution (Campbell et al. 2016).

Focusing on three regions, Sub-Saharan Africa, South Asia, and Latin America that together represent 55 percent of the developing world's population, Rigaud *et al.* (2018) finds that climate change will push tens of millions of people to migrate within their countries by 2050. They made projections that, without concrete climate and development action, just over 143 million people or around 2.8 percent of the population of these three regions could be forced to move within their own countries to escape the slow-onset impacts of climate change. They estimated that by 2050, Latin America will record 17 million internal climate migrants, 40 million in South Asia and 86 million in Sub-Saharan Africa. From the estimation, it is evident that sub Saharan Africa will be recording the highest proportion of internal migration and this could result from the fact that, the region is prone to climate change. A large proportion of migrants are from rural areas and depend mostly on agricultural sectors and natural resources for their livelihoods (FAO, 2017). Far reaching experience has shown that the increase in drought is driving growing number of people from rural areas to the cities (WorldRiskReport, 2014). Because of the geographical location of Ghana, the impact of the climate change is severe in the northern part of the country, causing several people to migrate to the southern part in search of better opportunities (Kudjey, 2014). It has become an integral part of the local economy and an important livelihood strategy for the residents in the Nadowli District of Ghana (Rademacher-Schulz & Mahama, 2010).

In times of crisis, when neither husband nor wife have enough means to provide for the family, Rademacher-Schulz & Mahama, (2010) indicated that men and sometimes even women with children are forced into seasonal migration. Migration in general is predominantly of seasonal rural-rural type. Male migration still is more common and better perceived by society than female migration. Seasonal mobility according to Tacoli (2011) takes place during the agricultural slack season and is predominant in the poorest areas relying on rain-fed agriculture. Seasonal movement is largely determined by the lack of local non-farm opportunities.

The issue of migration from rural areas to the urban centers is not welcoming news to city planners as much of key and emerging global climate risks are concentrated in urban areas. Force migration (displacement) hinders development in at least four ways; by increasing pressure on urban infrastructure and services, undermining economic growth and increasing risks of conflicts (Brown, 2008). Urban climate change risks, vulnerabilities, and impacts are increasing across the world in urban centers of all sizes, economic conditions, and site characteristics (Revi *et al.*, 2014). Movement of people to these cities are rapidly stretching the city as a system to its limits, in particular cases is the case of acute or creeping disaster (WRR, 2014). Urban areas hold more than half the world's population and most of its built assets and economic activities. They also house a high proportion of the population and economic activities most at risk from climate change, and a high proportion of global greenhouse gas emissions are generated by urban-based activities and residents (Revi *et al.* 2014). Revi *et al.* (2014) established that rapid urbanization and rapid growth of large cities in low and middle-income countries have been accompanied by the rapid growth of highly vulnerable urban communities living in informal settlements, many of which are on land at high risk from extreme weather.

Migrants themselves may be vulnerable to climate change impact in destination areas, particularly in urban centers in developing countries (Adger *et al.* 2014). Force migration (displacement) worsen health, education and social indicators of migrants themselves (Brown, 2008). On one hand, migration of young men can lead to the ageing and feminization of the rural population and place greater burdens of work on those who remain (FAO, 2017). Skilled migrants are the net fiscal contributors and their departure therefore represents a loss for those left behind. There will also be an inequality of skilled and unskilled labour as loss of skilled labour will decrease productivity of unskilled labour and increase productivity of skilled labour (Waldinger & Fankhauser, 2015). Migration that is not adequately foreseen and facilitated in climate-sensitive and vulnerable situations can jeopardize food security in both places of origin and destination (FAO, 2017). Access to information on the economic and social costs of migration, the advantage and disadvantages of potential destination locations, and the absence of credit constraints can help potential migrants make decisions that will improve their livelihoods (Waldinger & Fankhauser, 2015)

2.4.5 Institutional governance to enhance resilience and adaptive capacity

Ensuring environmental sustainability is one of the key agendas of global development partners (UNDP, 2011). The Global Leadership for Climate Action (2009) indicated that climate change will have significant impacts on development, and poverty alleviation. Climate change will lead to new challenges to states and will increasingly shape both conditions of food security and national security policies (Adger *et al.*, 2014). As a result, climate change policies at the national level are expressed through national action plans for adaptation and national appropriate mitigation actions. Better integration of food security, safety nets, and adaptation policies offers the potential to reap significant benefits (Deve, 2011; Selvaraju *et al.*, 2006). National Adaptation Programs of Action (NAPAs) are an essential first step for countries to identify priority activities that respond to their urgent and immediate needs to adapt to climate change (GLCA, 2009).

Government action is needed to create an enabling environment for adaptation. This includes removing existing financial, legal, institutional and knowledge barriers to adaptation, and strengthening the capacity of people and organizations to adapt (Klein, *et al.*, 2008).

In some nations, the links between climate change and its impact have been recognized and are starting to be addressed through varying degrees within many global regimes (Revi *et al.*, 2014; Stapleton *et al.*, 2017; Martin, 2010). Ghana for instance is a signatory to a number of global interventions on climate change and disasters. For example, Ghana is a party to the United Nations Framework Convention on Climate Change (UNFCCC), by which national governments are expected to take climate change issues into consideration in national development planning. The Hyogo Framework for Action (HFA), 2005–2015, on the other hand, aims at reducing substantially the number of casualties as well as the socioeconomic and environmental losses resulting from disasters (The Republic of Ghana, 2015). Of course, other examples of purported progress include the United Nations Framework Convention on Climate Change (UNFCCC), the Sendai Framework for Disaster Risk Reduction 2015–2030 (SFDRR) and the United Nations Convention to Combat Desertification (UNCCD). The Platform on Disaster Displacement (PDD) has an important role to play in supporting national governments to mainstream approaches to human mobility into broader policies. The 2030 Agenda for Sustainable Development (2030 Agenda) includes Sustainable Development Goals (SDGs) which has as one of the key targets, a mitigation of the impact of climate change. The 2030 Agenda for Sustainable Development emphasizes the need for international cooperation to enable safe, orderly and regular migration (FOA, 2017).

Strategies and measures for the sustainable management of natural resources can support broad improvements in livelihood security and household and community capacity to cope with climate impacts (Martins, 2010; Elasha, 2006; Selvaraju et al. 2006). Additionally, sustainable management and use of agricultural, fishery, aquaculture and forest resources enhances resilience against climate risks, and contributes to creating jobs (FAO, 2017). Planning for the development of agriculture in Ghana has focused on increasing productivity and production; there has been little focus on addressing climatic constraints. Mainstreaming climate change and variability into food and agricultural development planning has become necessary to ensure the sustainability of achievements. In addressing the challenges of climate change, FAO has contributed Resilience-building initiatives include disaster risk reduction in agriculture sectors aimed at reducing damage and loss due to climate related disasters. These include: “Caisses de résilience”, which promote investments in good agricultural practices and the development of institutional and technical capacities; and Safe Access to Fuel (SAFE) – an initiative that helps meet the energy needs of both migrant and host populations in emergency and protracted crisis situations.

Also, The Barind Multipurpose Development Agency (BMDA), with its formal mandate to provide deep tube well irrigation, plays a lead role but does not focus on areas where groundwater is not accessible. Local disaster management committees exist (Selvaraju *et al.*, 2006). The National Climate Change Policy (NCCP), which a policy which provides a clearly defined pathway for dealing with the challenges of climate change. Focus Areas are: develop climate-resilient agriculture and food security systems; build climate-resilient infrastructure; increase resilience of vulnerable communities to climate-related risks; increase carbon sinks; improve management and resilience of terrestrial, aquatic and marine ecosystems; address the impact of climate change on human health; minimize the impact of climate change on access to water and sanitation; address gender issues in climate change; address climate change and migration; and minimize greenhouse gas emissions (Republic of Ghana, 2015)

A widely-held understanding that human skills are critical to coping and resilience serves to emphasize the inter-related nature of many of the indicators of coping capacity explored through the case studies. Specifically, many of the things that enabled improved coping capacity within

households and communities also required improved human capacity – from animal health care skills, to mechanical skills for the maintenance of machinery, to soil management skills, to community organizational capabilities. As the breadth and depth of human skills and capacity grows, so grows resilience and adaptive capacity (Elasha, 2006). The Ministry of Environment, Science, Technology and Innovation, through the Government of Ghana has reported that awareness-raising, capacity-building, improved training curricula and appropriate integration into existing processes will effectively mainstream climate change into the food and agricultural sector policies (Republic of Ghana, 2015). There are effort currently going on at the Wa agricultural research station of the Savannah Agriculture Research Institute (SARI) to educate farmers on the use of agro-meteorological information to guide their farming operation (UNDP, 2011).

Flexible credit policies played a major role in improving the financial capital in the three case study areas. In addition, the capacity to finance not only coping mechanisms but also livelihood diversification activities that can pre-emptively lower climate vulnerability is key. In this sense, savings in liquid or like form (e.g., livestock, food stores) are critical, as is access to micro-credit to temporarily substitute for liquid assets (Elasha, 2006). This is because; focusing on climate change without factoring in local context is leading to some bizarre policy distortion (Brown, 2008). Similarly, alleviating poverty nor decreasing vulnerability to climate change cannot be achieved unless entrenched inequalities are reduced (Olsson et al. 2014). But the capacities of these institutions for advocating adaptation practices are limited and coordination among NGOs and government agencies at local level appears weak (Selvaraju et al. 2006). Due to these, many local households rather view the performance of governmental institutions more negatively compared to their own risk management performance (Birkmann et al. 2017). According to Adger et al. (2014) study on human security in climate change, indigenous, local and traditional knowledge are often neglected in such policy and research, however, their mutual recognition and integration with scientific knowledge will increase the effectiveness of these policies and adaptation.

2.5 Conceptual Framework

The study adopted the conceptual framework developed by the Department for International Development (DFID, 1999). The framework explains the relationship among different variables such as livelihood assets, livelihood strategies and livelihood outcome. As shown in Figure 2.1,

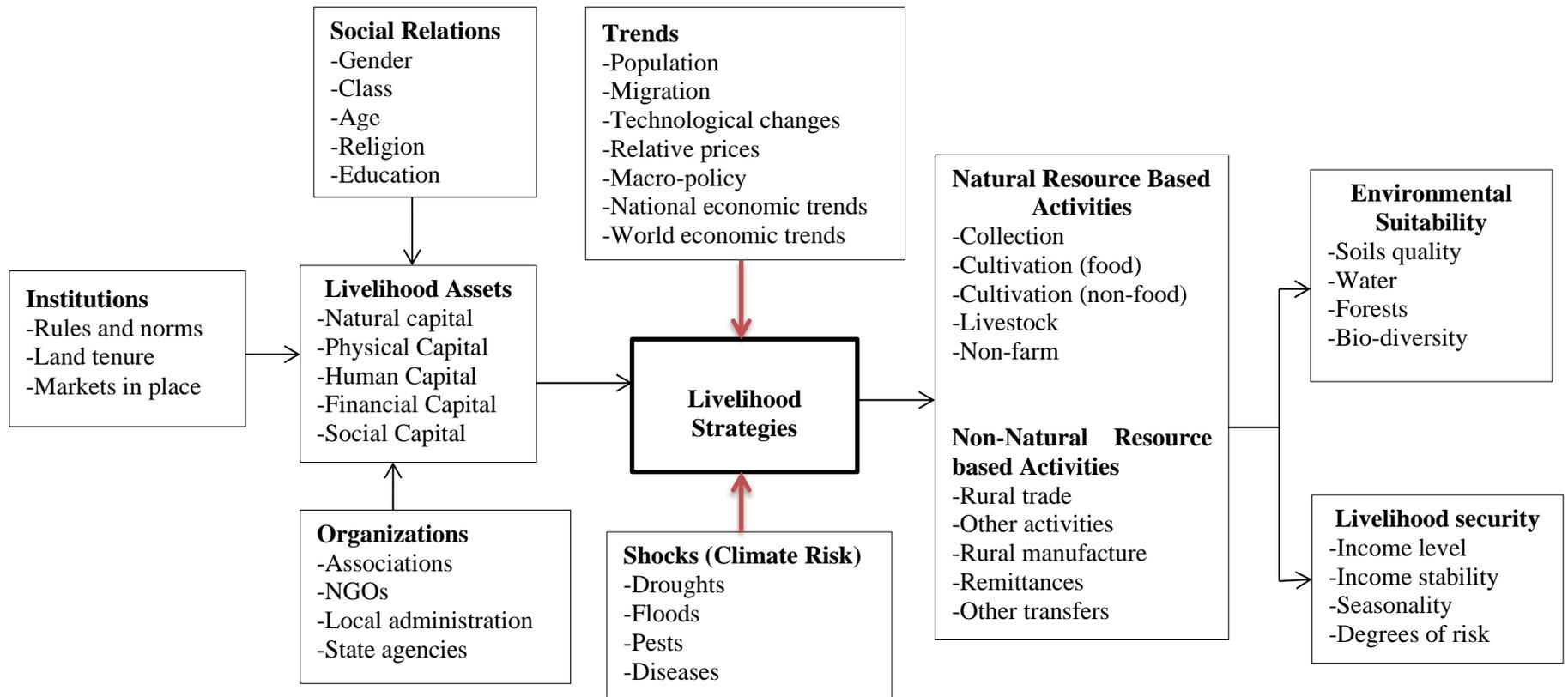
the various livelihood assets include natural capital, physical capital, human capital, financial capital, and social capital. These livelihood assets are shaped by interrelationships among variables including institutions, organizations and social relations.

Households often drive their livelihood strategies from their immediate livelihood assets. Their strategies are usually in the form of primary, secondary and tertiary production activities. However, in the hinterlands, majority of the households are engaged in primary production activities such as agriculture. From Figure 2.1, the livelihood strategies can be influenced by climatic shocks such as droughts, floods, pest and diseases that affect both plant and animal life. This means that climate variability can have a harmful effect on rural households. Besides, economic, social, and technological changes can shape households' livelihoods. This can take different trends such as population dynamics, migration, price volatility, economic policy, and the effect of the international market. These variables are the external factors that change household livelihood strategies.

The livelihood outcomes are in twofold: (1) natural resource-based activities, and (2) non-natural resource-based activities. The natural resource base activities are the direct primary production activities engaged in by the households. Examples include the collection (of firewood), cultivation of food crops, cultivation of non-food crops such as timber, cotton among others. Others include livestock rearing, and non-farm activities. Secondly, the non-natural resource-based activities include rural trade, rural infrastructure, and remittances. The framework implies that households who are engaged in livelihood activities often measure their outcomes in terms of the natural and non-natural resource activities.

Finally, the framework in Figure 2.1 provides an indication of the effects of the livelihood outcome. DFID (1999) suggests two main livelihood effects, which include environmental sustainability, and livelihood security. The environmental sustainability is measured in terms of soil quality, water availability, forest resources, and bio-diversity conservation. Besides, the livelihood security variables include income levels, income stability, seasonality, and degree of risk associated with the livelihood.

Figure 2.1: Conceptual Framework



Source: DFID (1999)

Empirical studies such as Gyampoh *et al* (2011) maintains that changes in climatic conditions are having a significant influence on household livelihoods in Ghana. According to this study, most of the households' studied are engaged in farming, fishing and trade and hence are affected by climatic variables such as droughts, floods, diseases and pest. Besides, Gyampoh *et al* (2011) concludes that most households are coping with their current situations based on their indigenous knowledge and this brings to the fore the role of institutions such as rules and norms in the sustainable livelihood framework. Dasgupta *et al.* (2014) point out that, changes in agricultural production, resulting from climate variability will have a corresponding impact on incomes and well-being of rural people. This means that climatic shocks as indicated in the framework in Figure 2.1 will affect the livelihood outcomes (natural and non-natural resource-based activities) indirectly through changes in the livelihood strategies. The same study therefore, maintained that such rural households could mitigate the associated climate risk through diversification, migration, technology adoption as suggested by the sustainable livelihood framework.

According to Adger *et al.* (2014), some households are already socially marginalized, natural resource dependent, and having limited capital assets. This means that their adaptive capacities are less, making them vulnerable to climate variability. Such households will therefore, need strong institutions to protect their natural resources especially, when they are shared between different groups of people with different cultures. Besides, such situations may require a strong intervention of state, and private sector organisations, NGOs and self-help initiatives to cope with the situation (Vorsh, 2015). The conceptual framework captured this by recognizing the role of organizations, institutions and social relations as main drivers in shaping the livelihood assets of groups of people.

Empirical studies have demonstrated the practical application of the sustainable livelihood framework. For instance, Dube and Phiri (2013) found that, traditional and indigenous fruits are disappearing due to reduced precipitation and increasing temperature. This results in inadequate soil moisture hence giving rise to poor soil formation. The framework in Figure 2.1 captured this as the effects of the livelihood outcomes with specific examples as biodiversity conservation, forest management, soil and water quality. Appieah *et al.* (2018) explains with evidence from rural Ghana that, smallholder farmers are most hit by the adverse effects of climate change. Their livelihood activities give rise to deforestation, and bush burning which are considered as negative effects of their livelihood outcome. Increment in prices over the last five years has threatened

secure livelihoods of farm households (Gawu, 2012). This implies that price changes in the past have not improved rural households' livelihood thus making them vulnerable.

2.6 Conclusion

The review of empirical studies has revealed that climate variability is one of the key issues that affect livelihoods of households, especially those in rural areas. Climate variability is uncertain because rural households are unable to assign probabilities to the occurrence of climatic variables. This introduces risk in production as farmers, in particular, lack knowledge on when unfavourable events such as drought, floods, and diseases will occur. Some households have resulted to strategies such as migration to cope with climate risks while others remain vulnerable because of weak adaptive capacity. In the rural setting, migration often take the form of rural-urban while those who do not migrate remain in the rural areas but take remittances from their relatives in the city. This suggests the existence of rural urban-linkages in climate change and migration nexus. Most of the empirical studies in Ghana are silent on the link between rural and urban areas in climate change discussions. Evidence from empirical literature implies that institutional roles in providing resilience to climate change are necessary in most developing countries. However, the role of institutions in climate change mitigation is questioned in the Wa Municipality because households remain vulnerable to the harmful effects of climate variability.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presents the general procedures used in carrying out the study. First, it introduces the study area by describing its physical, social, and economic profile. Besides, the chapter presents the research design, a description of the study population, sampling procedure, sources of data and instruments of data collection. Finally, the chapter presents the methods of data analysis.

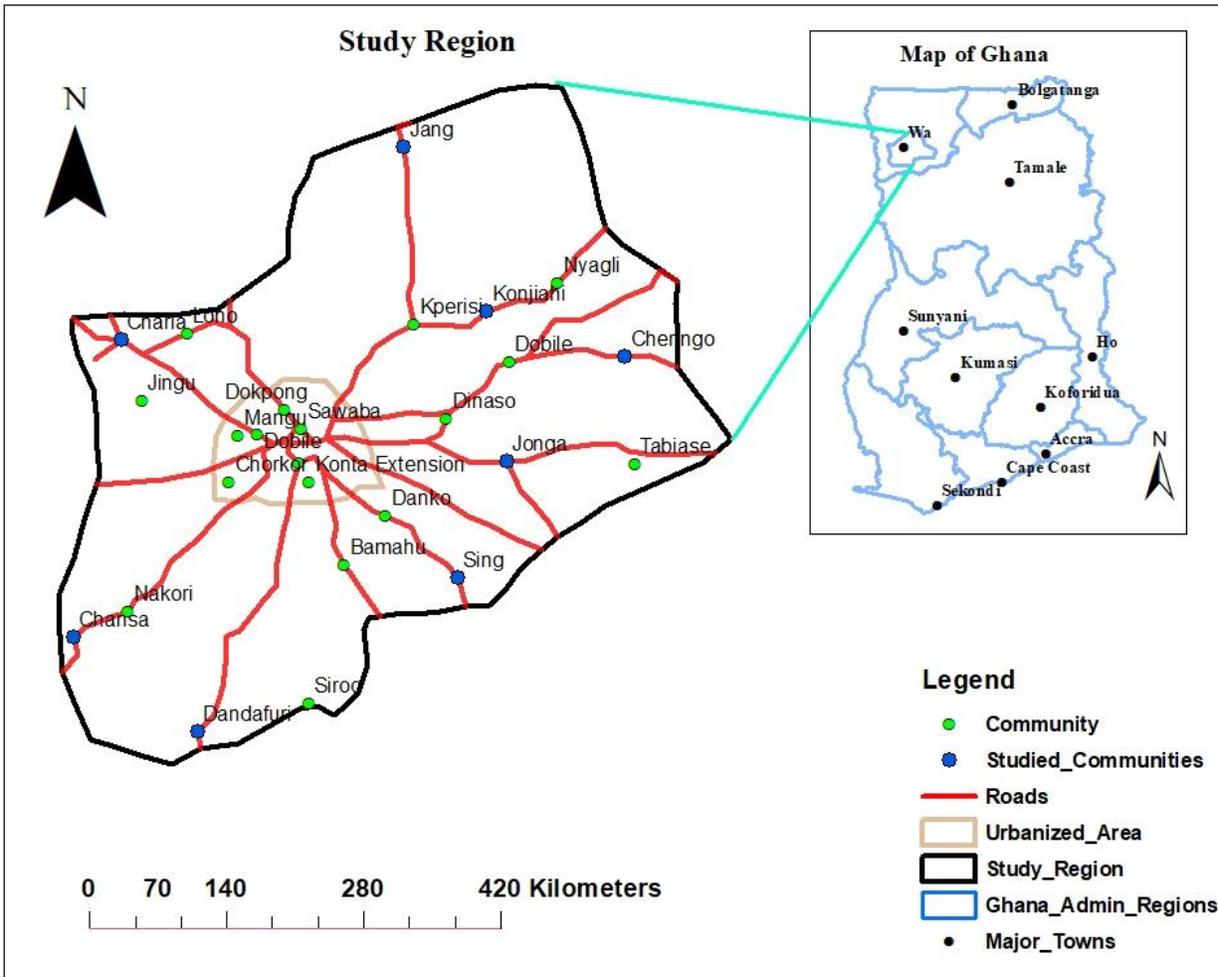
3.2 Study Context

The Wa municipal and its surrounding communities are located within the North-Western part of Ghana. It shares boundaries with Nadwoli-Kaleo District to the North, Wa East District to the East, and Wa West District along the Southern part. The area is situated within latitudes 1°40'N to 2°45'N and longitudes 9°32'W to 10°20'W. It has a land area of about 579.86 square kilometers. The total population of the area stands at approximately 125,816. About 66.3 percent of the population is within the urban settlement whereas 33.7 percent are rural. The sex ratio of the study location currently stands at 97.7 percent (Ghana Statistical Service, 2014).

The region is within the Savanna plains, largely undulating. It has an average height of between 160 meters and 300 meters above sea level. The area has two main soil types; these are the laterite ant ochrosols. Clay soils are also found in some communities like Charia, where it is mostly used for pottery. The laterite soils are largely found within the area and its mostly harvested for road construction and housing development. The savannah ochrosols type of soils supports the cultivation of a variety of food crops such as millet, sorghum, soya beans, groundnuts, yams and rice (Ghana Statistical Service, 2014).

The dependency ration stands at 59.4 percent for the urban population and 77.5 percent for the rural inhabitants. A large proportion of the population are between the ages of 20 – 24. This indicates a youthful population and is characteristic of developing countries. The general fertility rate in the area is currently 82.63 percent (Ghana Statistical Service, 2014). The ensuing figure presents a graphical overview of the study location.

Figure 3.2: Map of Wa Municipality and the hinterland that make up the Study Region



Source: Digitized and modified from GSS, 2013

The vegetative cover is largely of the guinea savannah grassland, which is composed of relatively short trees. There are also shrubs of different kinds. The grass is dominant during the rainy season. On the climate, the area has two main seasons, the rainy season and the dry season, the South-Western Monsoon wind from the Atlantic Ocean comes along with rains that spans from April to October. The North-Eastern Trade Winds from the Sahara Desert normally cause the dry season, which runs from November to March each year. The average annual rainfall range between 840mm and 1400mm (GSS, 2013).

3.3 Research Design

The author adopted survey method for the design. The rationale was that, the study was descriptive, and households selected as unit of analysis, this makes the survey method appropriate for the study. Research design is a comprehensive plan for data collection in an empirical research project. It is a “blueprint” for empirical research aimed at answering specific research questions or testing specific hypotheses (Leary, 2001; Bhattacharjee, 2012). It forms the architecture of every study and explains how the study is going to be constructed (Kumar, 2011). The design therefore, represents plans and procedures for research that span the decisions from broad assumptions to detailed methods of data collection and analysis (Creswell, 2009; Neuman, 2014). According to Kumar (2011), the design explains the method of enquiry, the objective and the approach (quantitative, qualitative or mixed methods). Several research designs such as explorative, descriptive, survey, case studies among others (Kumar, 2011) are available to social scientist. The choice of any of these designs is determined by the objective of the study.

Besides, three main research approaches have been identified in social science. They include qualitative, quantitative and mixed methods (Kumar, 2011; Creswell, 2014). The distinction between qualitative and quantitative research is framed in terms of using words (qualitative) rather than numbers (quantitative), or close-ended questions rather than open-ended questions. Mixed methods strategy resides in the middle of this continuum because it incorporates elements of both qualitative and quantitative approaches (Creswell, 2014). Researchers choose among these approaches based on the philosophical assumptions underlying the study. While qualitative approach gathers data on emerging issues based on the participants’ settings, quantitative research aims at testing objective theories by examining the relationship among variables.

Generally, the design, which minimizes bias but maximizes the reliability of the data collected is considered a good design (Kothari, 2004). Such a design is characterized by a smallest experimental error but supposed to yield maximal information and provides an opportunity for considering many different aspects of a problem. Thus, the question of good design is related to the purpose or objective of the research problem and also with the nature of the problem to be studied. This study therefore, adopted the survey design in investigating into vulnerability and climate risks in the Wa city region. The survey design usually produces a ‘snapshot’ of a

population at a particular point in time (Cohen et al., 2007). The survey method is generalized and can be used for descriptive, exploratory, or explanatory research. This method is best suited for studies that have individual people as the unit of analysis (Bhattacharjee, 2012). The relative strength of the survey method informs the choice of it for this study.

The approach to enquiry was based on the mixed methods, which combined both qualitative and quantitative methods. The quantitative aspects of the study dealt with issues such as households' awareness of climate impact, their vulnerability to climate change, the influence of urban-rural linkages on livelihood security, and climate variability and internal migration. The qualitative aspects of the study dealt with analysis of the institutional governance to boost resilience and adaptive capacity to climate change. The use of mixed methods is considered appropriate because qualitative data can support statistical results to establish a link or relationships among variables.

3.4 Target Population

The study population consists of household heads in the Wa City Region and institutions responsible for boosting resilience to climate change. The Ghana Statistical Service (2014) estimates that the Wa Municipality has 102,264 households. This consists of 68,203 urban and 34,061 rural. This means that rural household population constitutes 33.3% of the Wa Municipality while the urban household population constitutes 66.7%. However, population dynamics over the years means that these statistics are not static but change over time, hence making the population of the study infinite. Household heads are included in the study as target population because they are the direct victims of the impact of climate change. Households are the smallest units of society and are therefore at risk of climate variability, especially when it bothers on livelihoods. They are also key players in mitigating the effects of climate change in the course of carrying out their social, cultural and economic activities. Besides, the institutions included in the target population are the Ministry of Food and Agriculture, The Town and Country Planning Department, The Forest Service Division, the Environmental Protection Agency and the Wa Municipal Assembly. The functions of these institutions have implications on environmental quality, sustainability and climate risks.

3.5 Sampling

This section describes the sampling design of the household interviews. It specifically presents the sample size determination, and the procedure for selecting the respondents for the study. Multistage sampling technique was employed to select the communities, the houses, households and subsequently household heads. Purposive sampling technique was used to select the institutions based on relevance, activities and location.

3.5.1 Sample size

The sample size for the study was determined using the formula specified by Panneerselvam (2007) as:

$$n = \frac{Z^2 * P(1 - P)}{D^2}$$

Where;

n = Required Sample Size

Z = Confidence level at 95% (standard value of 1.96)

P = Estimated prevalence of respondents' in the population

M = Margin of error at 5% (standard value of 0.05)

This procedure is feasible when the population is not known with certainty, and the population standard deviation is not known.

Guided by previous studies (Inkoom & Nanguo, 2011; Ghana Statistical Service, 2008), the value of P (proportion of households that are at risk of climate variability in the study area) was considered as 86%. This proportion represents households in the same area that are engaged in activities that are sensitive to climate variability. In the rural setting, most of such people are into crop and animal production. Hence the require sample size is:

$$\begin{aligned}n &= \frac{1.96^2 * 0.86(1 - 0.86)}{0.05^2} \\n &= \frac{0.4625}{0.0025} \\n &= 185\end{aligned}$$

The required sample size for the study is 185 household heads. These were selected from both rural and urban areas of the Wa City Region.

3.5.2 Procedure for selection

The respondents were selected using both probability and non-probability sampling procedures. First, the type of probability sampling procedure used is the multi-stage. This was used to select the communities, the houses and further, the households' heads. The first stage selected rural and urban communities, and the second stage involved the selection of household heads from the selected communities. In the selected communities, it was possible to construct a sample frame by using the housing numbering system. Houses were therefore, selected after which a household in the selected house is considered using a simple random sampling.

The selection of the institutions was done using a purposive sampling procedure. The reason was based on the fact that the administrative heads of such institutions were expected to have in-depth knowledge on issues regarding how their institutions responds to climate change issues in the city region. Besides, such respondents are responsible for implementing state policies and strategies adopted to improve resilience in climate change.

3.6 Sources of data

Data were gathered from both primary and secondary sources. The primary data were gathered from both households and institutional respondents on awareness, livelihoods, climate change impacts, and preparedness for climate change impact. However, the secondary data were collected on past performance of some sectors such as agriculture production in the past 10 years. This was used to compare current performance in the analysis of climate change effects.

3.7 Methods and Tools of Data collection

The main methods, tools and instruments used in the collection of primary data were questionnaire, interview guide, and Focus Group Discussion.

3.7.1 Questionnaire

Questionnaires were used as instruments for data collection. This was administered to households both within the city and in the hinterland. A total of 185 questionnaires were administered to the respondents. A questionnaire is a document containing questions and other types of items such as statements designed to solicit information on specific issues, themes, problems or opinions to be investigated (Kumekpor, 2002). The questionnaire in this study contains both close ended and

open-ended questions. Data were collected from household heads. This instrument was considered because of its relative advantage of collecting data from large number of respondents.

The questionnaires were constructed based on the key variables of the study. They are resources, livelihood, family, information, income and farming. Series of questions were asked around these variables to elicit responses from households both in the city and within the hinterland. Copies of the questionnaires are provided in the appendix of the report.

3.7.2 Key Informants Interview

Key Informants are individuals who are articulated and knowledgeable about a subject matter. They are usually very informative and possess insight and understanding of specific issues (Kothari, 2004). Interviews are a more personalized form of data collection method than questionnaires, and conducted by trained interviewers using the same research protocol as questionnaire surveys (i.e., a standardized set of questions) (Bhattacharjee, 2012). Besides, the interviewer has the opportunity to clarify any issues raised by the respondent or ask probing or follow-up questions. In this study, the administrative heads of institutions responsible for boasting resilience to climate change were interviewed at their respective offices (work places). The issues discussed with the respondents include their responsibilities, the role of their institutions in boasting resilience to climate change, their current projects that are geared towards combating the negative impacts of climate change, strategies in boasting resilience, their challenges in terms of resources and governance.

Their responses were recorded and summarized as part of the data analysis of the study.

3.7.3 Focus Group Discussion

Majority of household's heads surveyed were males. It was necessary to include gender dimension in the analysis because males head majority of households in the study region. It was therefore imperative to obtain the views and opinions of the women, who are themselves farmers, and in most cases support their families' income. The FGD was conducted in three separate communities- Jankore, Holomuni and Buffiama. The three communities were purposively selected to give the process a spatial relevance.

Focus Group Discussion is a form of qualitative research in which attitudes, opinions or perceptions towards an issue, product, service or program are explored through a free and open

discussion between members of a group and the researcher (Kumar, 2011). It is a rapid assessment, semi-structured, data gathering process in which participants are purposely selected by the researcher to discuss issues and concerns on key themes on the subject under investigation. It takes a form of group interview in which there are several participants in addition to the moderator/facilitator (Ofori & Dampson, 2011). There is emphasis in the questioning on a particular tightly defined topic and the goal is upon interaction within the group. Tayie (2005) also indicates that in FGD, from six to 12 people are interviewed simultaneously, with a moderator leading the respondents in a relatively free discussion about the focal topic.

The number and size of groups to consider according to Ofori and Dampson (2011) depends on the nature of the study. They added that involving many groups will provide comprehensive responses about the phenomenon under investigation but will increase the complexity of the analysis since it will be difficult to determine who says what. Many studies therefore, increase the group size and limit the number of groups or the vice versa. In this study, women in two separate communities were organized into groups for a discussion on climate change effects on their livelihoods and their preparedness for the impact of climate change impact.

3.8 Method of data analysis

Data collected through the questionnaires were coded and entered into the SPSS spread sheet where all needed transformations were done. Both descriptive and inferential statistics were computed from the data as methods of analysis. Specifically, descriptive statistics were used to analyze households' awareness of climate variability and effects on their livelihood. The influence of rural-urban linkages on vulnerability and the influence of climate change on internal migration and its subsequent effects on livelihoods. Various cross tabulations were generated and chi-square test of independence was performed. The qualitative data were summarized into themes and discussed. The data were presented in the form of quotations that represents the direct views of the respondents.

3.9 Analytical Framework

The study adopted the bottom-up approach in assessing climate vulnerability at the local level. The bottom-up approach is more relevant to the study because, it is being conducted in a developing country setting, and within the smallest unit of the local governance structure in Ghana. The study

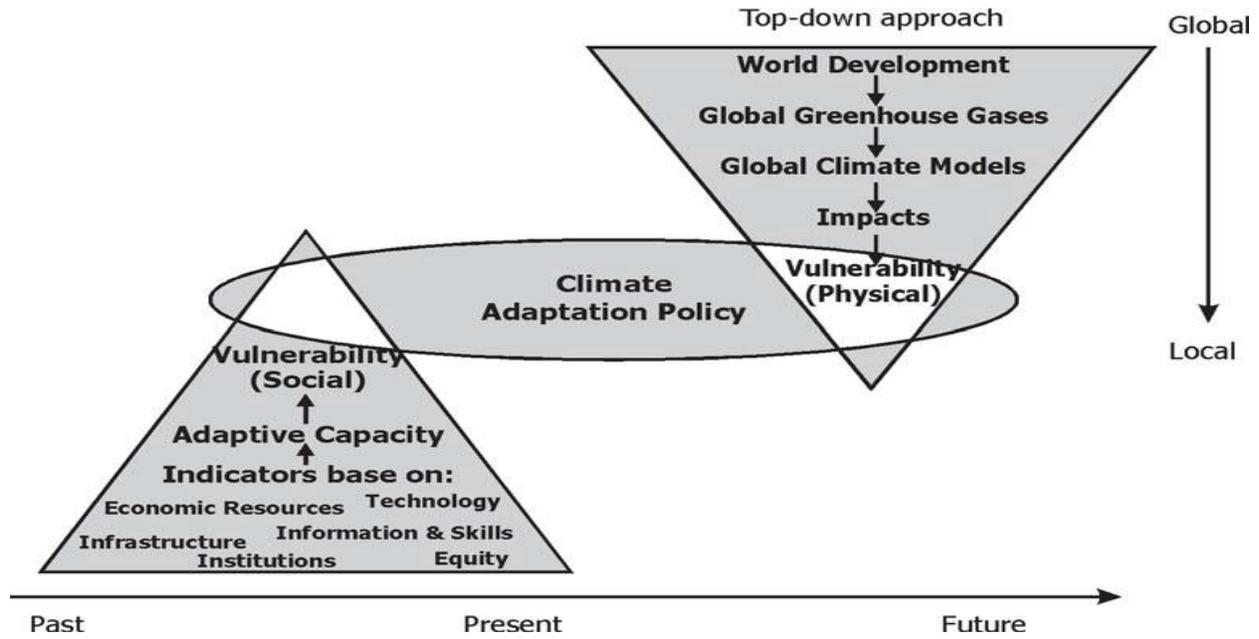
location is also at the smallest division of spatial resolution within the country context. This is also due to the fact that, current climate vulnerability in developing countries is generally viewed as a threat to livelihood (M.E.F.C.C&GIZ, 2014). This informs the decision to adopt this approach as a framework to guide the analysis of the study data. The framework presented a sense of reasoning for the study. It shaped the entire fabric of the analysis by tuning the analysis to the local setting.

Vulnerability in climate Change assessment is based on two main approaches: top-down and bottom-up approaches. The work of Sociologist, psychologists and Political Scientists illuminate both the top-down and bottom-up approaches. These contributions therefore, drive the ideologies concerning climate change (Jacquet *et al.*, 2014). Jacquet *et al.* (2014) explain that the institutional approaches emphasize the importance of top-down forms of elite communications such as those related to corporate strategy and mainstream media. On the other hand, the behavioural approaches focus on bottom-up processes such as group and systems justification in climate change. Many approaches are hybrids between the various approaches and the future climate regime will probably contain elements of both the top-down and the bottom-up approach (Andresenn, 2016). Top-down approaches are frameworks that are designed to help understand the potential long-term impacts of climate change (Nair & Bharat, 2011). This is a probabilistic understanding of future changes analyzed at the macro level. On the other hand, bottom up assessment approaches address near term concerns. Bottom-up assessment models examine technological options or project-specific climate change mitigation policies (Nair & Bharat 2011). These approaches are illustrated in Figure 2.1.

From Figure 2.1, the top-down approaches are concern with world development issues such as Global Greenhouse Effects and impact on climate change. These macro level decisions are then incorporated in to local policies for mitigation of climate change and physical vulnerability. On the other hand, the framework in Figure 2.1 shows that the bottom-up approaches analyses climate change issues from the local levels and then integrate them into the national and international climate discourse. At this level, the indicators are selected based on economic resources, technological skills, infrastructure and the indigenous potentials at the local level. However, both

the top-down and bottom-up approaches aim the formulation of climate change policy that will boost resilience for both the social and physical vulnerability.

Figure 3.3: Top-down and Bottom-up Approach to Climate Change



Adapted from Nair and Bharat (2011)

Top-down approaches propose for effort sharing that represents visionary yet contentious understanding of how to achieve integrity in global climate policy (Pickering, 2015). According to Nicholls *et al.* (2015), top-down offer the advantage of efficiency and economies of scale while bottom-up methods offer potential gains in accuracy owing to more immediate data collection and reporting. The decision to use top-down or bottom-up method can have important influence on the outcome. While top-down proposals offer greater transparency than the bottom-up approaches, in some respects, they generally, provide an incomplete answer to the question of how to ensure high quality deliberation and the participation of the interest most affected by climate change. Besides, the inability of nations to develop an integrated top-down climate regime is now widely accepted. Dittrich (2016) further argued that a top-down approach will not always be implemented, given the political cycle which result in decision making with a five-year perspective when appropriate adaptation action might require planning for much longer times.

The weaknesses associated with the top-down approaches have motivated behavioural approaches to have a focus on the bottom-up processes. Since top-down approaches have failed, there is the need to consider how more experimentalist bottom-up arrangements might work by decomposing problems into smaller units that facilitate testing and learning. Besides, Corsi (2017) indicate that the growing perception that states policies and planning decisions were not ambitious enough to prevent harmful interferences to climate change systems resulted in a new approach to climate change litigation characterized by the presence of numerous innovations. According to Andresen (2016), the pragmatic position of bottom-up approach is that climate change policies should be design and implemented at the lowest feasible level of organizations. Bottom-up approaches therefore, start with the household (Dittrich, 2016). The bottom-up strategy therefore, relies on a variety of smaller scale transnational cooperative arrangements involving not only states but sub-national jurisdictions, firms, and Civil Society Organizations to undertake activities towards climate change mitigation (Stewart *et al.*, 2013). The institutional arrangement adopted by the bottom-up approach is what makes it feasible in countries with weak institutional governance. It is therefore, very instrumental in mobilizing and harnessing the diverse incentives and energies of all levels of government, of firms, and other non-governmental actors to undertake actions to boost resilience to climate change.

Recent cases on climate change are presenting a systematic bottom-up effort whereby individual citizens or groups are suing states and national bodies, holding them responsible for failing to adequately combat climate change (Corsi, 2017). In the bottom-up approach, district level adaptation indicators are integrated into sectorial and national plans, feeding into the development of standard national plan (Kajumba *et al.*, 2016). The bottom-up approach is therefore, beneficial to decentralized and sub-national governments actions. Because locally led initiatives are quite compelling. Local governments can be more innovative and responsive to local environmental preferences and economic circumstances (Lutsey & Sperling, 2008). This approach corresponds with the decentralization system of Ghana where planning decision starts at the lower level and integrated into the national plans.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the results and discussions of the study. The results and discussion cover several variables with much focus on the objectives under investigation. First, analysis of the findings is done on the background characteristics of the respondents. The other sections of the chapter present discussion on awareness of climate change impact, vulnerability and climate change risk, the influence of urban-rural linkages on vulnerability and livelihood security, and the institutional governance to boost resilience and adaptive capacity.

4.2 Background Information of Respondents

The respondents were found to have different levels of educational attainment. The various categories of formal education achievement as shown in Table 4.1 include those with no form of formal education, basic education, second cycle education and those with tertiary level of education. The results suggest that respondents with basic education dominate (34.6%) over the other categories. However, those with no form of formal education represents 31.9% and this is more than those with secondary or tertiary education are. Tertiary educational attainment has been observed to be less (10.8%) among the respondents.

Table 4.1: Level of formal education

Level of education	Frequency	Percent
No Education	59	31.9
Basic	64	34.6
Second Cycle	42	22.7
Tertiary	20	10.8
Total	185	100.0

Source: Field Survey (2018)

The findings on formal education attainment imply that 68.1% have at least acquired basic education. This achievement can be very useful in climate change discussions since majority of households will be able to read and understand current debates on climate change impact and its

mitigation. However, those without formal education will have challenges in discovering information on climate change unless they are approached through specific interventions.

It was found that male respondents dominate over females. From Table 4.2, males represent 80.5% while females constitute 19.5%. This means that majority of households in the Wa city region are headed by males. This is expected since the various ethnic groups in the Wa Municipality practice the patrilineal system which give male household members the relative strength of heading households in decision making.

Table 4.2: Location of Respondents

Location	Frequency	Percent
Hinterland	62	33.5
City	123	66.5
Total	185	100.0

Gender	Frequency	Percent
Male	149	80.5
Female	36	19.5
Total	185	100.0

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Household size	185	3	25	6.91	3.213
Age of respondent	185	24	65	38.99	8.256
Monthly Income	185	83.00	1666.00	577.97	317.125

Source: Field Survey (2018)

The results in Table 4.2 also reveal the distribution of respondents' household size, age and monthly income. The descriptive statistics of these variables reported include the minimum observations, maximum, mean and standard deviations. From the table, the respondents are mostly in their youthfully age as indicated by the mean age of 38.9. Besides, average household recorded is seven and this means that many of the households have almost seven members. The income distribution suggests that respondents earn between GHC83.0 and GHC1666.00 per month. The mean income means that some of the respondents have sufficient income to mitigate the effects of climate change. However, some of the respondent earnings is relatively small as indicated by the minimum income to enable them prepare enough for climate change effects.

Further descriptive statistics of respondents' background information are reported in Table 4.3. The results in the table reveal the distribution of age and households among urban and rural households. There is a rural urban difference in the distribution of age and household size. The minimum household size remains the same for both the hinterland and the city but the maximum observation of household size suggests that rural households have more members than those in the city. However, the distribution of household size is more spread in the hinterlands than in the city as suggested by the standard deviations. It was also observed that rural households' heads are usually older than those in the city are. The results in Table 4.3 indicate that a mean age of 41.9 for those in the hinterlands and 37.5 for those in the city. Besides, in the rural areas, people as early as 24 years can become household heads while a minimum of 28 years for city dwellers to become a household head. The variations suggest that rural households will relatively more burden because of both the early entry and late exits of household headship.

Table 4.3: Age and Household Size across Location

Location	Variable	N	Min	Max	Mean	Std. Deviation
Hinterland	Household size	62	3	25	8.85	4.526
	Age	62	24	65	41.92	10.582
City	Household size	123	3	11	5.93	1.559
	Age	123	28	51	37.51	6.344

Source: Field Survey (2018)

The background information of the respondents suggests that there are some rural urban differences in the Wa city region. Households in the hinterland have more members with a relatively both young and older heads. The difference will have different implications on their preparedness for climate change impact.

4.3 Awareness of climate change impact

4.3.1 Awareness

The respondents were asked to indicate whether they have experienced the effect of climate change on their livelihood and their responses are shown in Table 4.4. It was discovered that 103 respondents who represent 55.7% confirmed that their livelihoods have been affected because of

climate change. This means that such respondents are aware of the occurrence of climate change in their locations. When asked specifically, whether they receive information on climate change, 75.1% of them said no and this means that any awareness on climate change issues will be due to personal experience. All the respondents generally agreed that they would want to respond to climate change by modifying their livelihoods if they receive information on it.

Table 4.4: Awareness of climate change

Effect of Climate Change on Livelihood	Frequency	Percent
Yes	103	55.7
No	82	44.3
Total	185	100.0
Receive any Information/education		
Yes	46	24.9
No	139	75.1
Total	185	100.0
If informed would you modify your Livelihood		
Yes	185	100.0

Source: Field Survey (2018)

There are mixed findings on people awareness of climate change impact in the Wa City Region. While majority indicated that they have notice climate change effect on their livelihood, only a small proportion (24.9%) have received information on climate change issues. This means that climate change awareness creation has not made significant impact in the Wa City Region. However, the effect of climate change is so severe that people are able to experience it in their livelihood strategies.

4.3.2 Rural and Urban difference in access to information

Further analysis was done on how access to climate change information varies by respondents' location. A cross tabulation of the two variables was generated and a chi-square test of independence performed. The null hypothesis was that, access to information is independent of household location (hinterland or city). The results as shown in Table 4.5 reported a Chi-square

value of 23.96 and this is significant at 1%. This provides enough evidence to reject the claim that access to information is independent of respondent location.

Table 4.5: Receipt of Information by Location

Location	Receive any Information/education		Total
	Yes	No	
Hinterland	29 (63.0%)	33 (23.7%)	62 (33.5%)
City	17 (37.0%)	106 (76.3%)	123 (66.5%)
Total	46 (100.0%)	139 (100.0%)	185 (100.0%)

Observation = 185, Pearson Chi-Square = 23.96, df = 1, Asymp. Sig (2-sided) = 0.00

Source: Field Survey (2018)

Once access to information is influenced by respondent location, it is evidence in Table 4.5 that more people in the hinterlands (63.0%) receive information on climate change than those in the city (37.0%). On the other hand, majority (76.3%) of those in the city do not have any information on climate change because their livelihoods are not directly derived from agriculture and hence are not very much concern on information regarding rains and temperatures (elements of climate).

4.3.3 Sources of information on climate change

It was also discovered that households have different sources from which they receive information on climate change. The sources cut across different mediums including both private and public institutions as shown in Table 4.6. From the table, the main sources include radio, television, and Ministry of Agriculture (MoFA). Other sources include information sharing among farmers, the Information Service Department, the Metrological Service, and the internet (for those who could use the internet).

Table 4.6: Institution/Source to seek information

Institution	Frequency	Percent
No response	65	35.1
From my fellow farmers	4	2.1
Information service	4	2.2
Metrological service	12	6.5
MoFA	33	17.8

Radio	37	20.0
Television	20	10.8
Through the internet	10	5.4
Total	185	100.0

Source: Field Survey (2018)

In the Wa Municipality, various radio stations disseminate public information in local languages to enable wider access. This means that such radio stations also present issues regarding climate variability and livelihoods and this explains why radio is the main common source of information access among households. The results also suggest that the Ministry of Agriculture has been making efforts to reach households, especially farmers with information on climate change. Other state institutions besides MoFA are the Meteorological Service and Information Service Departments that are very useful in climate change information to aid household preparedness.

4.4 Vulnerability and climate change risk

4.4.1 Climate change and livelihoods

The foregoing discussions have established that 55.7% of the respondents are aware of climate change impact and 44.3% are not. Further results in Table 4.7 provide evidence of how climate change makes households vulnerable through changes in their livelihoods. It was noted that, climate change effects on livelihood include the occurrence of drought, incidence of pest and diseases, increase food prices, ban on sale of some commodities such as meat, late farming, low yields, and the likelihood of desertification.

Table 4.7: Effects of Climate Variability on Livelihood

Effect of Climate Variability on Livelihood	Frequency	Percent
No response	100	54.1
Drought	2	1.1
Incidence of Pets and diseases.	14	7.6
Ban on selling beef meet	4	2.2
Increased cost of living.	2	1.1

Increased in Food Prices	24	13.0
Late farming	9	4.9
Likelihood desertification	7	3.8
Low customers patronage	4	2.2
Low yield	14	7.6
Poor Plant Germination	5	2.7
Total	185	100.0

Source: Field Survey (2018)

The results in Table 4.7 above imply that the respondents are feeling the effects of climate change in their livelihoods. Besides, the effects of climate change are being felt in different aspects of household livelihood either directly or indirectly. For example, it has a direct effect on agricultural production through the occurrence of drought, pest and diseases. These variables lead to late farming, late germination of seeds, and poor yields. On the other hand, the occurrences of diseases sometimes lead to a ban on sale of meat especially, when it is suspected that such meat might have been infected. Another indirect effect that has been observed is an increase in food prices. Food shortages may occur because of poor yields and this will create a deficit in market demand for foodstuff. The immediate economic consequences will be a rise in price level. The findings means that some households will become vulnerable to the effects of climate change if they do not have strong adaptive capacity.

4.4.2 Vulnerability

The survey provided evidence of how vulnerable households are, to climate variability. First the respondents were asked to indicate whether their livelihoods are being threatened as a result of climate variability. It was discovered as shown in Table 4.8 that 107 respondents who represent 57.8% maintain that climate variability has threatened their livelihood while 42.2% said no and this means their livelihoods have not been threatened by climate variability. This suggests that the respondents who indicated that their livelihoods have been threatened are vulnerable to climate variability. This category of respondents forms the majority of the sample and this explains the extent to which climate variability has introduced vulnerability among households in the Wa City Region.

Besides, Majority (54.6%) of the respondents have recorded loss in their production consistently in the past 10 years. This means that climatic conditions have resulted in decrease in crop performance in the past decade. Evidence of vulnerability is that the occurrence of low yields for that period is long and this suggests that such category of people do not have adequate preparedness to mitigate the effects of climate variability.

However, the results in Table 4.8 indicate that 149 respondents who represent 80.5% of the sample still produce enough for their families and this is one of the factors that sustain households despite their vulnerability to climate variability. Besides, 94.1% of the respondents still maintain their existing source of livelihoods because they have not changed their occupations even in the presence of climate variability. This also suggests that some households do have ready alternative means of responding to the effects of climate variability despite their vulnerable nature.

Table 4.8: Climate Variability and Vulnerability

Variable	Frequency	Percent
Has climate variability threaten your livelihood		
Yes	107	57.8
No	78	42.2
Total	185	100.0
Recorded any loses in the last ten years		
Yes	101	54.6
No	84	45.4
Total	185	100.0
Produce sufficient for your family		
Yes	149	80.5
No	36	19.5
Total	185	100.0
Have you change your occupation		
Yes	11	5.9
No	174	94.1
Total	185	100.0

Source: Field Survey (2018)

The results on climate variability imply that households have evidence of their vulnerability to climate variability through a consistent reduction in crop performance over the past decade. Based on this, their livelihoods are threatened and this requires immediate action to mitigate the effects of climate variability. However, many of them remain in their existing livelihood strategies, which further suggest that they have limited alternatives even with their experience of climate variability.

4.4.3 Crop performance in the presence of climate variability

The results of the study indicate that 32.4% of the respondents earn their livelihoods from farming. This category of respondents described the performance of crop yield in various forms. The evidence in Table 4.9 suggests that crop performance has not been favourable to any farmer in the Wa City Region. Farmers described the crop yields as bad, declining, low performance, moderate, not good, poor yields, and very bad. Only in some few cases that some described their performance as normal or sufficient.

Table 4.9: Crop performance in the presence of climate variability

Are you into farming	Frequency	Percent
Yes	60	32.4
No	125	67.6
Total	185	100.0
If yes, what has been your performance (crop yield)		
No Response	125	67.6
Bad	6	3.2
Declining	30	16.2
Low performance	4	2.2
Moderate	3	1.6
Normal	5	2.7
Not good	2	1.1
Poor yield	6	3.2
Sufficient	2	1.1
Very bad	2	1.1
Total	185	100.0

Source: Field Survey (2018)

Majority (16.2) among the farmers described their crop performance as declining and various responses have been given by the farmers as the cause of their declining crop performance. From Table 4.10, the respondents cited a change in fertilizer application, climate variability, drought and poor rains. The results imply that farmers have attributed the cause of their crop yield decline to climate variability and its associated consequences. Majority (92.4%) of the respondents have indicated that they are not pleased with their crop performance. However, their response to the question of whether their current conditions were due to climatic conditions suggests that they are not very certain on the influence of climate variability on their crop performance. The evidence in Table 4.10 is that only a small proportion (30.8%) maintained that their current conditions were due to climatic conditions. This was expected because the proportion of farmers is not significantly different from these respondents. This further suggests that, people that are in occupations not directly related to farming may not consider climatic factors as the main influence of their low performance.

Table 4.10: Respondents Opinion on the Cause of Crop Performance

What account for your current crop performance	Frequency	Percent
No response	126	68.1
Change in fertilizer application	10	5.4
Climate variability	6	3.2
Drought	9	4.9
Poor rains	34	18.4
Total	185	100.0
Satisfied with current crop performance	Frequency	Percent
Yes	14	7.6
No	171	92.4
Total	185	100.0
Crop performance due to climatic conditions	Frequency	Percent
Yes	57	30.8
No	128	69.2
Total	185	100.0

Source: Field Survey (2018)

4.4.4 Vulnerability in rural and urban households

This section discusses vulnerability to climate change among rural and urban households. The analysis was done using chi-square test of independence. From Table 4.11, when asked whether they have recorded losses in the past ten years, the responses were yes or no for both rural and urban households. The null hypothesis was that recording of losses or not is independent of households' location. The observed chi-square test value was 3.703 and this was significant at 10%. This means that there is enough evidence to reject the claim of independence of performance in the past ten years and respondent location. Hence, performance of rural households in the last ten years is different from those in the city. This is true from table 4.11, which indicates that number of respondents (64.5%) from the hinterlands are vulnerable than those in the city (49.6%) in terms of record of loses in the past ten years.

The respondents were also asked to indicate whether their production levels were enough for their families. Their responses as shown in Table 4.11 indicate that 87% of those in the city maintain that their production levels are adequate for their families while 67.7% of those in the hinterlands have their output being sufficient for their families. Besides, a chi-square test value of 9.74 was recorded, and this is significant at 1%. This means that the independence of whether output is sufficient for the family unrelated location of respondents should be rejected. This means that the response recorded vary by location and it is enough to conclude that households in the city are less vulnerable than those in the hinterlands in terms of sufficiency of their output for their families.

The results also include an analysis of household occupation. As to whether their occupations were sustainable. The respondents were asked to indicate whether their current occupation were sustainable. From the results in Table 4.11, 58.1% of those in the hinterlands answered yes while 77.2% of those in the city said yes. This means that majority of the respondents from either hinterlands or city considered their current occupations as sustainable. Further analysis was done to test the independence of the responses by location using chi-square test. From Table 4.11, a chi-square test value of 7.33 was observed, and this was significant at 1%. This means that, independence of the variables should be rejected. The conclusion is that there is enough evidence that households in the city have more sustainable occupations than those in the hinterlands in the event of climate variability.

Table 4.11: Climate Vulnerability and Location

Variable	Location		Total	Chi ²	df	P-Value
	Hinterland	City				
Have you recorded any loses in the last ten years						
Yes	40 (64.5%)	61 (49.6%)	101 (54.6%)			
No	22 (35.5%)	62(50.4%)	84 (45.4%)			
Total	62 (100.0%)	123 (100.0%)	185 (100.0%)	3.703*	1	0.054
Is it sufficient for your family						
Yes	42 (67.7%)	107 (87.0%)	149(80.5%)			
No	20 (32.3%)	16 (13.0%)	36 (19.5%)			
Total	62 (100.0%)	123 (100.0%)	185 (100.0%)	9.74***	1	0.002
Is your occupation sustainable						
Yes	36 (58.1%)	95 (77.2%)	131 (70.8%)			
No	26 (41.9%)	28 (22.8%)	54 (29.2%)			
Total	62 (100.0%)	123 (100.0%)	185 (100.0%)	7.33***	1	0.007

***=Significant at 1%, **=significant at 5%, *=Significant at 10%

4.5 The influence of urban-rural linkages on vulnerability and livelihood security

4.5.1 Rural-urban linages

This section presents results and discussions on the influence of urban-rural linkages on vulnerability and livelihood security. Several urban-rural interactions have been discovered in the study and shown in Table 4.12. First, rural people often have relatives in the city that establish a linkage in their life. Sixty (60) respondents (96.8%) out of the 62 rural household respondents indicated that they have relatives in the city. This means that their social and economic life will in one-way link with that of the city. Further inquiries revealed that 51.6% of rural households often receive remittances from their relatives in the city. The rural respondents (77.4%) believe that their relatives in the city have better living conditions than they in the hinterlands are. This justifies the direction of flow of remittances from the city to the hinterlands. Previous discussions have revealed that households in the hinterlands are much affected by the adverse effects of climate variability

than those in the city. This has given city dwellers the advantage of better economic conditions than those in the hinterland. On the other hand, the flow of remittances from the city to rural households means that the urban-rural linkages are a form of relief for people from the impact of climate change since the remittances can be used to augment rural resources in the fight against climate variability.

The results in Table 4.12 also point out that, the rural households do not show preference for city life despite their relatively weak economic conditions. It was noted that majority (75.8%) of those in the hinterlands would not like to join their relatives in the city, and 71% stated that they do not wish to be in the city at all. This suggests that the current vulnerability associated with rural life on climate variability is not severe enough to cause strong preferences for city life. Hence, rural dwellers will be prepared to manage the adverse effects of climate variability than to join their relatives in the city.

Table 4.12: Rural-Urban Linkage

Do you have a family or relations in the city	Frequency	Percent
Yes	60	96.8
No	2	3.2
Total	62	100.0
If yes, do you receive remittance from them?		
Yes	32	51.6
No	30	48.4
Total	62	100.0
Do you feel they have better conditions than you do?		
Yes	48	77.4
No	14	22.6
Total	62	100.0
Would you like to join them in the city?		
Yes	15	24.2
No	47	75.8
Total	62	100.0
Do you wish you were in the city		

Yes	18	29.0
No	44	71.0
Total	62	100.0

Source: Field Survey (2018)

4.5.2 Urban rural linkages

Out of 185 respondents, 123 of the households have family or some form of relations in the hinterland. This category of respondents as shown in Table 4.13 confirmed that they have relatives in the hinterland. Besides, 77.2% of these people have indicated that they send remittances to their relatives in the hinterlands. When asked on the relative poverty situation of rural and urban households, 93.5% of urban respondents maintain that households in the hinterlands have poorer conditions of life than those in the city. This category of respondents also maintains that, they have better opportunities in terms of livelihood strategies than those in the hinterlands. Because of the conditions of those living in the hinterlands, no respondent in the city indicated that they would want to join their relatives in the hinterlands even if their situation changes.

Table 4.13: Urban – Rural Linkages

Do you have a family or relations in the Hinterland	Frequency	Percent
Yes	123	100.0
If yes, do you send remittance to them		
Yes	95	77.2
No	28	22.8
Total	123	100.0
Do you feel they have poorer conditions and less opportunities than you		
Yes	115	93.5
No	8	6.5
Total	123	100.0
Would you like to join them in the		
No	123	100.0
Would you move to the hinterland if your current circumstances change		
No	123	100.0

Source: Field Survey (2018)

4.5.3 Satisfaction with current location

Majority of the respondents were found to be satisfied with their current location (hinterland or city). When asked the question of whether the respondent is satisfied with their current location, the results as shown in Table 4.14 revealed that 95.2% of those in the hinterlands are satisfied with their current locations as rural people and only 4.8% were found not to be satisfied with the conditions of the rural area. On the other hand, all the respondents from the city maintained that, they are satisfied with the conditions of the city and hence will prefer to live there. The chi-square test of statistics was also reported in Table 4.14. From the table, the value of chi-square is significant at 5% and this means that satisfaction with the conditions of current location varies across rural and city dwellers. The conclusion is that rural people prefer to live in the rural areas while those in the city also prefer the city conditions.

Table 4.14: Satisfaction with Current Location

Satisfied with your current community	Location		Total
	Hinterland	City	
Yes	59 (95.2%)	123 (100.0%)	182 (98.4%)
No	3 (4.8%)	0 (0.0%)	3 (1.6%)
Total	62 (100.0%)	123 (100.0%)	185 (100.0%)

Observation = 185, Pearson Chi-Square = 6.05, df = 1, Asymp. Sig. (2-sided) = 0.014

Source: Field Survey (2018)

The results in Table 4.14 suggest that people have adjusted to their current conditions and hence have preferred their current location despite the current climatic conditions. This means that the people have adopted strategies to cope with the adverse conditions of climate variability in their locations otherwise they would have preferred to change their locations or indicate dissatisfaction with their current locations.

4.5.4 Availability of shared resources in rural and urban areas

Some respondents have indicated that there are shared resources among rural and urban areas that also influence their interactions. The common resources identified are shown in Table 4.15 include agricultural land, community forestry, irrigation dam, residential land and sand wining sites. Forty-four respondents identified these resources. However, the remaining 141 respondents (who form the majority) do not have any idea of the shared resources with rural or urban areas. The existence

of common resources between the city and the hinterlands means that, there would be interactions between the two geographic locations through sharing and utilization.

Table 4.15: Shared Resources among hinterlands and city dwellers

Shared resources	Frequency	Percent
No response	141	76.2
Agricultural Land	7	3.8
Community Forestry	7	3.8
Irrigation Dam	9	4.9
Residential Land	12	6.5
Sand/Gravel Mining	9	4.9
Total	185	100.0

Source: Field Survey (2018)

Further enquiries revealed that the resource sharing strategy determines the nature of interaction among rural and urban dwellers. From Table 4.16, some of the common resources often have conflicting use, and this means that there would not be peaceful interaction among the users. Resources with conflicting use include sand/gravel mining sites, agricultural lands, community forestry, and residential lands. Some of these resources have conflicting use with farming purposes or fuel wood gathering.

Table 4.16: How resources are shared between the city and hinterlands

How the resources are utilized	Shared Resources						Total
	Agricultural Land	Community Forestry	Irrigation Dam	Residential Land	Sand/Gravel Mining		
No response	141 (100%)	0 (0.0%)	0 (0.0%)	1 (11.1%)	0 (0.0%)	0 (0.0%)	142 (76.8%)
Conflicting use	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	8 (88.9%)	8 (4.3%)
Conflicting use	0 (0.0%)	7 (100%)	1 (14.3%)	0 (0.0%)	12 (100%)	1 (11.1%)	21 (11.4%)

Farming)	0(0.0%)	0(0.0%)	0(0.0%)	8(88.9%)	0(0.0%)	0(0.0%)	8 (4.3%)
Fuel wood)	0(0.0%)	0(0.0%)	6(85.7%)	0(0.0%)	0(0.0%)	0(0.0%)	6 (3.2%)
Total	141 (100%)	7 (100%)	7 (100%)	9 (100%)	12 (100%)	9 (100%)	185 (100.0%)

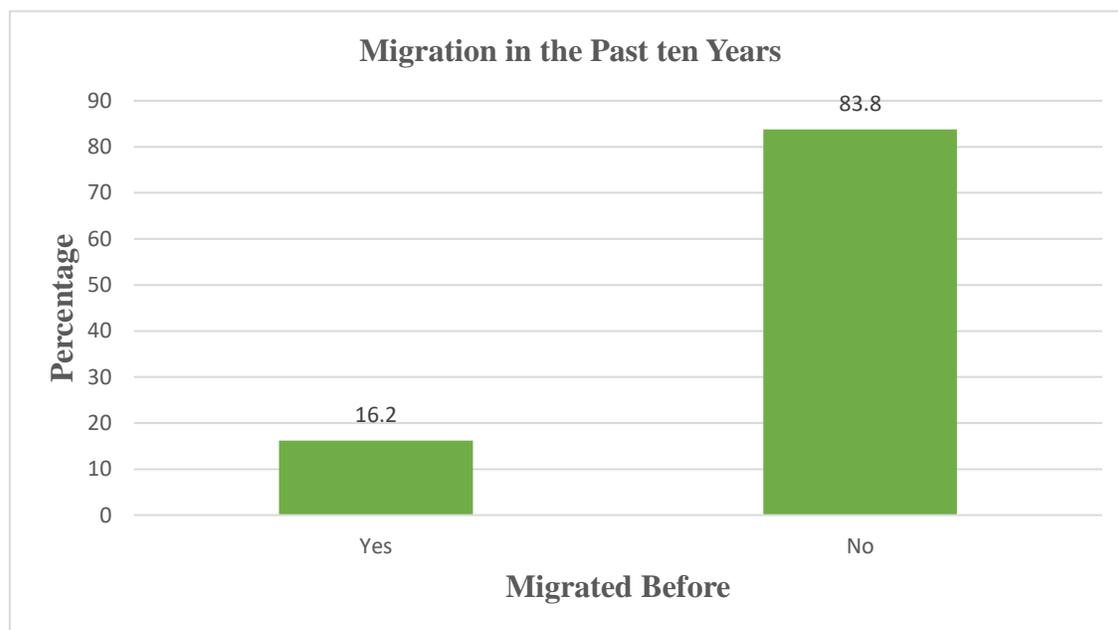
Source: Field Survey (2018)

4.6 Climate variability and internal migration

4.6.1 Migration in the past ten years

Climate change has caused migration of some households' members across locations. The results of the study revealed that, 30 respondents representing 16.2% have ever migrated before because of climate variability. On the other hand, 155 (83.8%) respondents have never migrated in the past ten years.

Figure 4.4: Migration of households in the past ten years

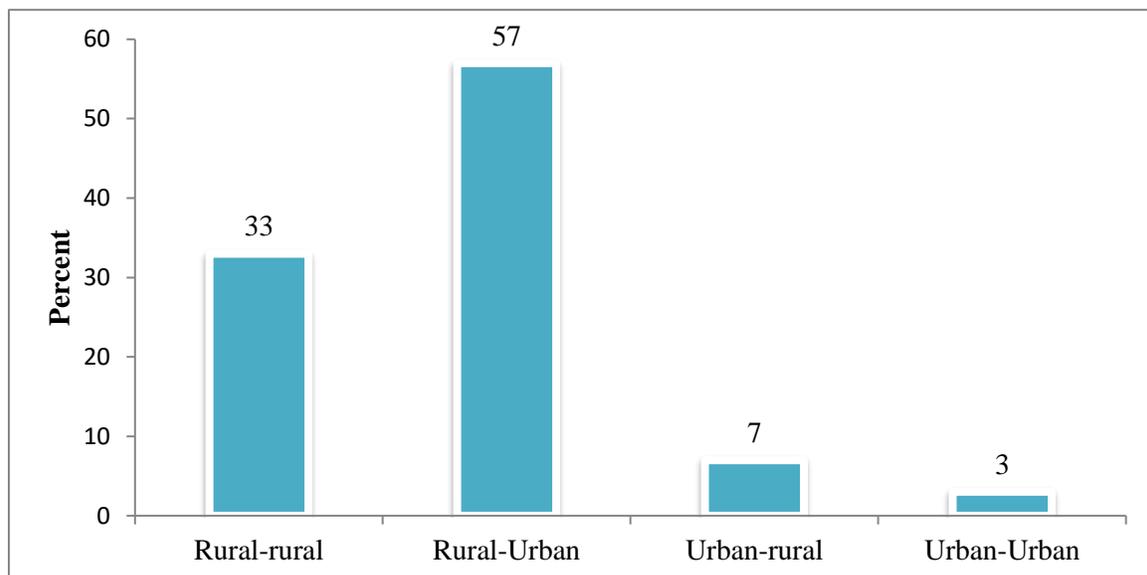


Source: Field Survey (2018)

4.6.2 Direction of movement

Further analysis provides the direction of movement in terms of rural urban in Figure 4.5. The nature of migration takes the form of rural-rural, rural-urban, urban-rural, and urban-urban. From the figure, 10 respondents representing 33% have migrated from rural areas to different rural areas, 17 respondents who represent 57% migrated from rural areas to urban areas, 2 respondents who represent 7% have migrated from urban areas to rural areas, and 1 respondent said that he has migrated from urban area to another urban area.

Figure 4.5: Direction of migration



Source: Field Survey (2018)

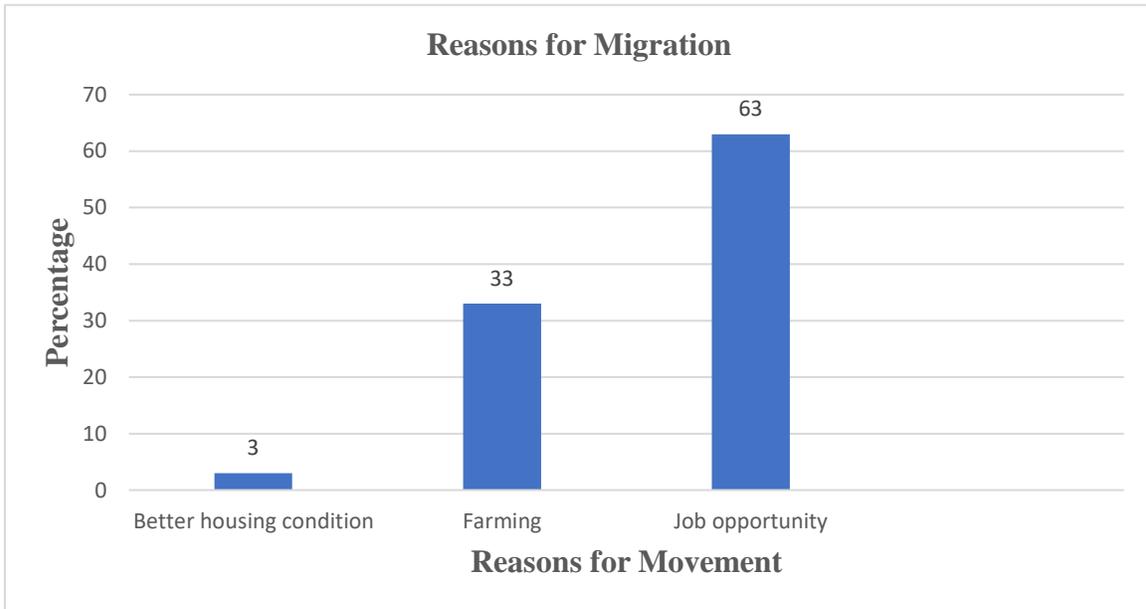
The direction of migration suggests that there is more rural urban migration than the other types as described and shown in Figure 4.2.

4.6.3 Reasons for migration

The respondents gave several reasons for migrating. Among them include, the search for a job opportunity, for farming purpose and for better conditions of life such as decent accommodation. The reasons for migration are shown in Figure 4.3. From the figure, only one respondent representing 3% of the migrants indicated that, he migrated in search of better housing condition.

Besides, 10 respondents who represent 33% maintain that they have migrated to be able to do better farming while 19 respondents who represent 63% maintained that, they have migrated because of job opportunities.

Figure 4.6: Reason for the movement



Source: Field Survey (2018)

From Figure 4.3, some households have migrated in search of better livelihoods in the destination places. Climate variability has threatened their livelihoods at the point of origin that necessitates the search for alternative livelihoods as a response to climate change. Quite related to the search of livelihoods is farming where people considered their farm output to be declining and have to look for places suitable for agricultural activities.

Further analysis was done to find out how the direction of migration relates to the reason for migration. A cross tabulation was generated for the two variables and the results are shown in Table 4.17. From the table, migration for a better housing condition was an urban-rural and this means that the respondent found it difficult getting a better housing facility in the city and has to seek a relief in the rural area. Those migrating for farming purpose are in the form of rural-rural. This means that such respondents had challenges in farming such as climate variability and has to relocate as a mechanism for coping with the adverse effects of climate change. On the other hand,

some rural people have to migrate to the city in search for better job opportunities. This means that such households have left their agrarian activities in the hinterlands for secondary and tertiary activities in the city. This also suggests that the households in the hinterlands are using migration and livelihood diversification as a strategy for adapting to the adverse effects of climate variability. The results also indicate that, a particular respondent was having a business in the hinterlands but has to relocate to the city to establish the business there.

Table 4.17: Reasons and direction of migration

Reason for the movement	Direction of movement					Total
	No response	rural-rural	Rural-Urban	Urban-rural	Urban-Urban	
	157 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	157 (84.9%)
Better Housing	0 (0.0%)	0(0.0%)	0(0.0%)	1(50.0%)	0(0.0%)	1(0.5%)
Farming	0 (0.0%)	8 (100%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	8 (4.3%)
Job opportunity	0(0.0%)	0 (0.0%)	17(100%)	0 (0.0%)	1(100%)	18(9.7%)
To setup business	0(0.0%)	0 (0.0%)	0(0.0%)	1(50.0%)	0(0.0%)	1(0.5%)
Total	157(100%)	8(100%)	17(100%)	2(100%)	1(100%)	185(100%)

Observation = 185, Pearson Chi-Square = 555, df = 16, Asymp. Sig. (2-sided) = 0.000

Source: Field Survey (2018)

A chi-square test of independence was performed and this resulted in an observed chi-square value of 555, which was significant at 1%. This means that the independence of direction of movement and reason for movement should be rejected. Hence, there is enough evidence to conclude that the nature and direction of migration is influenced by the reason for migration. From the findings, some households in the hinterlands who could not cope with the adverse effects of climate variability are seeking an alternative through migration. As a result, the nature and direction of migration is dictated by the reason behind the migration. Most often, farmers in the hinterlands who are affected by climate variability move to other hinterlands to continue their agricultural activities or move to the city and diversify their livelihood activities. The rural-rural migration implies that some hinterlands are least affected by the effect of climate variation. As a result, those who are still interested in agriculture resort to moving to areas with greater potentials of farming

activities. Those who move to the city and diversify their activities is very common in the Wa City Region and this explains why rural-urban migration is the commonest as reported by the findings of this study. The findings suggest that cities are least affected by climate variability because the livelihoods of households are mostly not primary production activities and hence not directly linked with climatic variables.

4.6.4 Relocation after adaptation to climate variability

For those who have migrated to different locations, they were asked to indicate whether they would move back to their original places after their conditions have improved. The results as shown in Table 4.18 revealed that 16.6% of the migrants will move back to their original locations if their circumstances have improved. On the other hand, 25 out of the 30 migrants who represent 83.3% maintained that, they will not move again even if their circumstances change for the better. This means that the effects of climate variability are very severe that most migrants would not want to go back to their places of origin even if their conditions have improved.

Furthermore, despite the adverse effects of climate change on agricultural production, most of the households in the hinterland (71%) as shown in Table 4.18 maintained that, they are not willing to move to the city because of climate variability. Only 29% of them prefer to move to the city as a response to climate change. Evidence in Table 4.18 also supports the argument that none of the respondents in the city would want to move to the hinterlands because of the adverse effects of climate variability.

Table 4.18: Relocation Decision

Would you move again if your current circumstances change	Frequency	Percent
Yes	5	16.6
No	25	83.3
Total	30	100
Would you like to move to the city	Frequency	Percent
Yes	18	29.0
No	44	71.0
Total	62	33.5
Would you like to move to the hinterland	Frequency	Percent

No	123	100
----	-----	-----

Source: Field Survey (2018)

The results imply that, climate change has induced internal migration more in the hinterlands than in the city. The phenomenon of internal migration is taking place in hinterlands as a responds to climate variability. It could also be deduced from the results that, people are much concern about their livelihoods in their internal migration decision. Besides, rural dwellers are more sensitive to climate change effects because the immediate consequences of climate changes such as drought, high temperatures affect agricultural production most. This explains why farmer households in the rural areas, are willing to relocate than those in the city.

4.7 Institutional governance to boost resilience and adaptive capacity

This result basically, was from institutions within the study location whose governance has implications on climatic conditions. They were the Wa Municipal Assembly, the Town and Country Planning Department, The Environmental Protection Agency, the Forestry Commission and the Municipal Agricultural Development Unit.

An interview with the assistant physical planning officer of the Wa Municipality on institutional governance to boost resilience and adaptive capacity to climate change revealed the following:

The main responsibility of the Physical Planning Department regarding resilience in climate change is by making provision for natural resources in the preparation of local plans as a conservative measure. As part of the processing of building permits, we have made it a requirement that all physical development must be carried out with tree planting. Ways of creating public awareness of this include radio discussion.

The caption means that, authority is making some effort indirectly to the fight against climate change. However, more still needs to be done to improve resilience to climate variability.

Besides, an interaction with the Upper West Regional Manager of the Forest Service Division revealed the following as their effort in boosting resilience to climate change:

The focus of the Forestry Service Division is to engage in plantation development and enforcement of laws to prevent deforestation and degradation. We are therefore, working towards our mandate

of protection, management and development of forestry resources. We do awareness creation through demonstration of pilot projects and through the media.

The findings imply that, the Commission views adequate vegetative cover as one of the means of strengthening resilience to climate change.

The department of Agriculture of the Wa Municipality also play significant role in boosting resilience and adaptive capacity to climate change. The main role of this institution is constant interaction with farmers to create their awareness of climate change and strategies for its mitigation. The District Director of Agriculture revealed the following to the researcher in an interview:

The Department of Agriculture contributes to boosting resilience to climate change through farmer education on technology adoption. The specific ways of creating awareness include demonstrations, farmer home visits, and radio discussions.

The results suggest that, the department is making conscious efforts in that regard, but largely it is still inadequate due to resource constraints.

Further, an interview with the programs officer of the Environmental Protection Agency, a legal, statutory body, with the mandate of protecting the environment and safeguarding its natural resources revealed that, the institution is making efforts in the combat of climate change through some projects.

Figure 4.4: An interaction with the Programs Officer of the EPA



Source: Field survey (June, 2018)

“We are currently educating farmers through a project called sustainable water and land management. We educate the farmers not to cultivate their lands closed to the water bodies. We rather encourage them to plant around the water bodies. We also encourage them to plant trees and not to clear many of the already existing trees during their farming activities. It’s a climate change adaptation project that is based on the Paris agreement” (Programs Officer EPA, 22.06.18. 15:35)

4.8 Focused Group Discussion

A focused group discussion was conducted in two separate communities-Chansa and Nyagli. The goal was to elicit the views and opinions of the women. About eighty percent of the household’s heads surveyed were males; however, there are homogenous groups within the various communities made up of women and women leaders, most of whom are farmers. It is therefore imperative to get their view of issues that are being investigated. In addition, the rationale of the study is to assess climate vulnerability and risks at the local level.

Figure 4.5: A Focused group Session with Women at Chansa



Source: Field survey (June, 2018)

“We used not to apply fertilizer to our crops, but we had good yield to feed ourselves and take care of our children. But now we have to buy a lot of fertilizer and still record low yields”
(Women’s Leader, 30th June, 2018)



Source: Field survey (June, 2018)

“We have realized it no longer rains like in the past, so we now cultivate crops such as okra, beans, water melon and pepper. We also attend our Village Saving and Loans Scheme every week so we can get loans to start small businesses”
(Member of the group).

Figure 4.6: A Focused group Session with Women at Nyagli



“I think those in town are somewhat better than us. I sell cooked food as part of my small farming practice; sometimes the food is not finished. However, it doesn’t happen that way in the town. However, I would not go to the town unless my husband decides to move” (Member of the group)

Source: Field survey (June, 2018)



“We use to pick the shear fruits, on average five bags, ten years ago. That was enough for our children school fees. Now we no longer get as much as that. Our animals now run diarrhea because they no longer get green grass to feed on” (member of the group)

Source: Field survey (June, 2018)

CHAPTER FIVE

GENERAL DISCUSSION, SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter introduces a general discussion on the findings of the study. It outlines a much broader discussion of all findings to the research questions. The general discussion also draws relationship among the major findings of the study and further presents an outlook. The rationale for the general discussion is to present an overall conversation of the findings that culminates all main findings and milestones of the study. The chapter also has as part of its content, a summary of the major findings, the conclusions of the study and policy recommendations for boosting resilience to climate change. The author derived the conclusions and recommendations from the findings of the study.

5.2 General discussion of Findings

This study assesses vulnerability and climate change risks in the Wa City Region with special focus on rural urban linkages. The aim was to examine how different groups of people in different geographic and socio-economic settings respond to climate change issues. How their interaction with the environment and with each other has made them vulnerable to climate change impact. The study therefore, argues that rural-urban interactions contribute to households' livelihoods, food security, vulnerability and climate change impact.

It emerged that, majority of household heads are males. This reflects the leadership dynamics that are still rampant in developing countries, especially in Sub-Saharan Africa. This implies that women are unable to take leading roles in household's decisions about livelihood strategies. They may not also be in the position to take strong decisions on livelihood modifications in a way of coping with the existing threats of climate change. However, most of the women are farmers and traders and contribute significantly to the family's income. They only lag behind when it comes to decisions and leadership.

Going forward, only education can act as a tool to bridge the gap that currently exist between men and women concerning leadership and decision-making. About fifty-nine percent of the respondents had no formal education, which reflects the level of inadequacy in terms of education. Development interventions in the area of education particularly girl-child education could make

significant difference in the near future and contribute greatly to adaptation efforts being pushed by the government and its development partners.

The author discovered that, closed to half of the study population are unaware of the current and future threat of climate change. This point out the inadequate dissemination of information on developing issues in the country, particularly the hinterland. Inadequate, and in some cases, no access to information in itself is a form of poverty. This in addition to the already existing income poverty and inadequate formal education retards and thwarts efforts of development partners and government in their quest to attain the UN-SDGs, which charges governments to end poverty in all its forms everywhere.

However, majority of respondents who have had knowledge and information of the current and existing threat of climate change were rural dwellers, who are mostly smallholder farmers. This proportion of Ghana's population contributes significantly to the food basket and subsequently to the GDP of the country. Agriculture remains the bedrock of Ghana's economy and therefore places some hope, that if policies, programs, and projects in the sector are properly designed, and implemented, it would produce results, and the country would be on the path towards poverty alleviation, wealth creation and attainment of the UN-SDGs.

Going forward, government could collaborate with local radio stations, which broadcast in the various local languages to adequately design local programs that would disseminate information about development issues including climate variability. The Information Service Department (ISD) could also be resourced and retooled to carry out its mandate effectively. Projects and programs which have a bearing on adaptation to climate change, could be developed, and organized together with community leadership-chiefs, youth groups, women groups and other homogenous groups within the various communities. This makes those projects and programs part of their culture and living and are more likely to achieve results. Recent studies have revealed that, projects and programs prepared with communities are more likely to succeed than those imposed on them, since the communities see the projects as part of them, own them, monitor and evaluate progress.

The study also revealed that, shared resources between various communities, especially the city and the hinterland has not benefited both geographic settings proportionally. Inhabitants in the city

as well as some organizations have converted farmlands into other forms of land use. It equally emerged that, some land owners within the hinterland have sold out their lands meant for farming. This was due to low incomes resulting from poor agricultural performance. Some inhabitants within the city, without white-collar jobs has resulted to sand/gravel mining from heather to agricultural lands shared between the city and the hinterland. Rural inhabitants on the other hand harvest fuel wood as their main source of primary energy from community afforestation sites. Conflicting use of shared resources Vis-a-Vis low-income levels is a complex phenomenon in the Wa city region. As government and its development partners push to eradicate poverty, agriculture, which remains the mainstay of the local economy of the Wa Municipal and Ghana as a whole, should have been the medium for development. These efforts are challenged, and highly hampered, by the loss of: arable agricultural lands, unplanned urban expansion, sand/gravel mining and other unhealthy environmental practices.

This could be addressed through sound urban planning and adequate regulation of various land uses in the city. Also, projects and programs on livelihood diversification could be designed to target smallholder farmers within the hinterland.

Internal migration is an inherent phenomenon within the study region. The study however, established that, the dynamics of internal migration is being induced and highly influenced by climate variability in recent years. Majority of farmer households that have migrated within the last ten years within the region gave reasons as to better opportunities. Further questions revealed that, they had to move because of erratic rainfall patterns, poor soil fertility, drought, pest and diseases, inadequate shrubs for farm animals. All these have led to poor yields, forcing them to move.

Going forward, internal migration could be a positive development issue within the study region, if appropriate policies are formulated, designed, implemented and evaluated. When small holder farmers move from one rural community to the other to produce more agricultural products, it's better than staying in the same community to produce low yields that contributes less or none at all to the GDP of the country. Migrated individuals send remittances to their former communities that contributes to development.

5.3 Specific Findings to Research Questions

5.3.1 Awareness of climate change impact

The study obtained mixed outcomes on respondents' awareness of climate change effect on their livelihood. The study discovered that 55.7% were aware while 44.3% not aware of climate change effects on their livelihoods. The limited awareness was because many respondents do not receive any information or education on climate change issues. However, there is opportunity for change because all the respondents are prepared to modify their livelihoods upon receiving information on climate change.

Access to relevant information on climate change is very important because it will broaden the knowledge of households in adaptation and mitigation. Opportunity for knowledge sharing on climate change in the Wa City Region is available. Common sources as identified in this study include farmers, information service providers, metrological service department, the Ministry of Food and Agriculture, and the media.

The study points out that more people in the hinterlands (63.0%) receive information on climate change than those in the city (37.0%). On the other hand, majority (76.3%) of those in the city do not have any information on climate change because their livelihoods are not directly derived from agriculture and hence are not very much concerned on information regarding rains and temperatures (elements of climate).

5.3.2 Vulnerability and climate change risks

It was noted that climate change effects on livelihood include the occurrence of drought, incidence of pest and diseases, increase food prices, ban on sale of some commodities such as meat, late farming, low yields, and the likelihood of desertification. This means that households that are extremely affected by these conditions are vulnerable to climate change and these possess challenges to their food security. The study revealed that 57.8% of the respondents have their livelihoods threaten from climate variability. The main effects are that 54.6% have recorded losses in the last ten years, 19.5% not able to produce sufficiently for their families, and 5.9% have changed their occupations because of climate variability.

Farmers are the category of people mostly affected by climate variability. It was discovered that farmers are experiencing declining crop yield performance resulting from climate variability. Specific challenges include change in fertilizer applications because of poor soils, drought and poor rains. These challenges informed the views of 92.4% of the respondents that they are not satisfied with their current crop performance relative to that of the past.

The results also include sustainability of respondents' occupation. It was found that, 58.1% of those in the hinterlands had their occupations sustained, while 77.2% of those in the city had their occupations sustained. This suggests that occupations are more sustainable in the city than in the hinterlands in the presence of climate variability.

5.3.3 The influence of Urban-rural linkages on vulnerability and food security

The study revealed that urban-rural interactions contribute to boosting resilience to climate change impact. Rural people often have their relatives in the city from which they receive remittances to augment their seasonal production levels. The results specified that 98.8% of rural people have their relatives in the city and 51.6% do receive remittances from them. The rural respondents (77.4%) believe that their relatives in the city have better living conditions than they are in the hinterlands. This justifies the direction of flow of remittances from the city to the hinterlands. On the other hand, the flow of remittances from the city to rural households means that the urban-rural linkages is a form of relief for people from the impact of climate change since the remittances can be used to augment rural resources in the fight against climate variability.

The urban households (77.2%) confirmed that they do send remittances to their relatives in the hinterlands. When asked on the relative poverty situation of rural and urban households, 93.5% of urban respondents maintain that households in the hinterlands have poorer conditions of life than those in the city. This offers City dwellers the opportunity to mitigate the effect of climate variability than those in the hinterlands.

However, 95.2% of those in the hinterlands are satisfied with their current locations as rural people and only 4.8% were noted not to be satisfied with the conditions of the rural area. This imply that, rural people are prepared to adapt to the adverse effects of climate variability than to migrate to

the city. On the other hand, all the respondents from the city maintain that they are satisfied with the conditions of the city and hence will prefer to live there.

One other important form of rural-urban interactions is the sharing of common resources. The study identified agricultural land, community forestry, irrigation dam, residential land, and sand/gravel mining sites as common resources shared between rural and urban households.

5.3.4 Climate variability and internal migration

Some (16.2%) respondents were found to have ever migrated in the past ten years as a result of climate change impact. The direction of migration includes rural-rural, rural-urban, urban rural and urban-urban. However, rural-rural and rural-urban are the dominants ones. The rural-rural migration occurs when farmers migrate from one rural area to another and the rural-urban is when farmers in rural areas move to urban areas in search for better production and livelihood alternatives.

The respondents have given reasons for engaging in internal migration. The main reasons include the search for job opportunities, farming purposes, and better housing conditions. Besides, the direction of migration is influenced by the reason for migrating. Households in the hinterland who could not cope with the adverse effects of climate variability are seeking an alternative through migration. As a result, the direction of migration is dictated by the reason for migration.

Majority (83.3%) of the households who have engaged in migrations maintain that they would not move back to their original places even if their circumstances change. This means that they have found better livelihood options in their destinations relative to their places of origin.

5.3.5 Institutional governance to boost resilience and adaptive capacity

The study pointed out that various institutions have been established in Ghana to boost resilience to climate change impact. Some of these institutions within the Wa City Region include the Town and Country Planning Department, the Forestry Service Commission, The Environmental Protection Agency and the Department of Agricultural Development.

These institutions usually, are responsible for public education and implementation of climate change adaptation and mitigation policies and programs. Key strategies adopted by these

institutions include incorporating climate change issues in development planning. For example, the Physical Planning Department has made it compulsory for allocating pieces of land for natural resource conservation. They also educate the public on climate change responds such as intensive preservation of natural resources. The Forestry Service Division has engaged in plantation development and enforcement of laws to prevent deforestation.

Besides, the Department of Agricultural Development contributes to resilience to climate change through farmer education on technologies and ways of coping with climate change impact. The activities of public institutions therefore, provided the opportunity for mitigating the effect of climate change in the Wa City Region. Besides, their educational programs facilitate the awareness creation on the dangers of climate variability and hence boosting their adaptive capacity.

5.3.6 Grey Areas

The author made some observations in the course of the study which were outside the scope and outline of the thesis. However, these areas are worth mentioning and relevant to efforts aimed at improving resilience, mitigating and coping with the adverse impacts of climate change, especially within the study location.

Though migration emerged as a positive phenomenon within the study region, there were negative aspects inherent within the whole issue of migration. A number of farmers have left their livelihoods and migrated to the city as an adaptation mechanism, however, they ended up in sand/gravel winning as their source of livelihood which contributes to deteriorating the environment.

Also, there exist a comprehensive climate change policy for the country, with clear policy objectives and annual action plans. However, implementation has been weak.

Further, it emerged that, smallholder farmers in the rural areas are applying indigenous knowledge and local systems for adaptation strategies to climate change impact. This could be examined further to assess how smallholder farmers are applying and adopting indigenous knowledge and local systems as adaptation and coping strategies.

5.4 Conclusion

Climate change has now gained attention by international, national and local organizations, including scholarly works on how to mitigate and adapt to its impact on human life. However, some people in the Wa City Region have not yet become aware of it. This means that they have not taken any deliberate measure towards its mitigation. However, mitigation and adaptation to climate change effects would have gained much support by households if they were informed about its occurrences and consequences. Besides, efforts to create awareness on climate change issues are concentrated in the hinterlands. This means that proponents of climate change considered the relative vulnerability to rural dwellers and hence neglect those in the city. This implies that efforts to combat the negative effects of climate change will gain less support by city dwellers.

Climate change has many effects on the livelihoods of households. The immediate ones include the introduction or spread of pest and disease, increased food prices, changing pattern of farming practices, and low crop yields. This means that households are vulnerable to climate change effects because their livelihoods are directly affected. If this trend continues into the future, the lives of people in rural areas particularly will be threatened.

One-way people are recovering from climate change effects whether planned or unplanned is developing rural urban linkages. Households in the hinterlands are building their relationships with their relatives in the cities and this result in transfer of benefits such as remittances to farm households to augment the unreliable agricultural output. This strategy is very reliable especially during the off-season where households lack foodstuff to feed themselves. On the other hand, resources are not being transferred from the city to the hinterlands among household's members. This implies that rural households are more vulnerable to the adverse effects of climate change than those in the city are.

Rural and urban households do have some resources in common. However, they have conflicting use of these resources and this can weaken their collective efforts in responding to the effects of climate variability. Natural resources such as agricultural lands and community forestry, which

could have been maintained to offset climate change, are exploited in different ways to fulfill housing needs and these facilitate climate variability in the Wa City Region.

Internal migration has been considered by rural households as a way of adapting to the effects of climate variability. Rural people who have more faith in agriculture are migrating to interior hinterlands where the soils are considered fertile and more arable for crop and animal production while others with less faith are relocating to the city for white color jobs. Besides, migrants are unwilling to move back to their places of origin, and this means that ongoing community development activities will be affected through the loss of labour force. This also further implies that, resources meant for development will be transferred to combat the adverse effects of climate change through efforts to minimize internal migration.

The efforts of institutions, to increase resilience and adaptive capacity to climate change through governance, have not been sufficient. The works of the Forestry Service Commission, the Physical Planning Department, Environmental Protection Agency and the Agricultural Development Unit have not been sufficient to protect the livelihoods of people from the adverse effects of climate change. Many people are not yet aware of climate change debate despite the fact that their lives have been affected. Besides, the institutions are mandated to protect natural resources yet these resources have been exploited in ways that promote the occurrence of climate change. This means that current institutional governance in climate change discourse has not been able to perform up to expectation in the Wa City Region.

In a wider perspective, the author encountered some questions during the course of the study. For instance, a question of if farmer households were taking measures against the risk of climate change, raised several responses, which further raised several questions. This could have been investigated further, to find out how small holder farmers are applying indigenous knowledge and local systems to cope and mitigate the adverse effects of climate change. However, it was beyond the framework, outline and scope of this study.

5.5 Recommendations

The results of the study have implications for national policy, regional planning, and household decision-making. The various recommendations are as follows:

Climate change has now gain impetus in scholarly debates but people who are to benefit from these discussions are not aware of climate change issues. This is prominent in the Wa City Region because 44.3% of households have not yet become aware of climate change discussions. There is the need for adequate and strong preparedness for climate change through: effective sensitizations on the occurrence, adaptation, and mitigation of climate change issues in the Wa City Region. The Government of Ghana, through the Ministry of Agriculture can engage in local stakeholder consultation to get all social groups involved in the creation of awareness and ways of adaptation to climate change effects. The Regional, Municipal and District Agricultural Development Units can be instrumental in this exercise by mobilizing farmer groups and associations for a collective action.

Community leaders (Chiefs, Youth Group Leaders, Women Groups, Religious leaders and Assemblypersons) are advised to take the lead in community mobilizations and serve as intermediaries between their communities and state institutions in creating awareness of climate change. Local arrangements and indigenous systems such as cultural events can be used as platforms for information dissemination on climate change issues.

This study revealed that farmers are the category of people who are mostly affected by climate variability. This means that they are the most vulnerable group that need livelihood improvement. This requires more policy attention. Appropriate intervention should include transformation in agricultural sector through the introduction of natural resources management technologies for farmers as a mitigation strategy to climate variability. The Ministry of Food and Agriculture should consider this as a key responsibility to discover more potentials for farming in the region. Effective technological revolution will lead to sustainable agriculture in the Wa City Region.

Urban-rural interactions have mixed effects on vulnerability of households. Households in the hinterlands receive remittances from their relatives in the city and this is an adaptive strategy to climate change. On the other hand, rural and urban areas do have common resources with conflicting uses. Resources that could be managed and used to mitigate climate variability are exploited by urban dwellers for the development of residential places. This study therefore,

recommends strong stakeholder collaboration between the hinterlands and the city on resource sharing. Formal institutions such as the Municipal Assembly should lead the initiative by creating the awareness of both parties on the relative importance of those shared natural resources in climate change mitigation.

A comprehensive development policy is required to build the capacity of state institutions that are mandated to implement projects and programs relating to climate change. Deliberate intervention is needed in the area of institutional governance to boost resilience to climate change. This can be effective by formulating climate change policy and supporting the implementing institutions with required human, logistics and financial resources in the fight against climate change impact.

REFERENCES

- Abbam, T., Johnson, F. A., Dash, J., & Padmadas, S. S. (2018). Spatiotemporal variations in rainfall and temperature in Ghana over the twentieth century, 1900–2014. *Earth and Space Science*, 5, 120–132. <https://doi.org/10.1002/2017EA000327>
- ADB (2012). Addressing Climate Change and Migration in Asia and the Pacific. ISBN 978-92-092-611-5. www.adb.org
- Adger, W.N., J.M. Pulhin, J. Barnett, G.D. Dabelko, G.K. Hovelsrud, M. Levy, Ú. Oswald Spring, and C.H. Vogel, (2014): *Human security. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects*. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 755-791.
- Appiah, D. O., Akondoh, A. C. K., Tabiri, R. K., & Donkor, A. A. (2018). Smallholder farmers' insight on climate change in rural Ghana. *Cogent Food & Agriculture*. 4: 1436211. <https://doi.org/10.1080/23311932.2018.1436211> www.CogentOA.com
- Birkmann, J. & Welle, T. (2016). The WorldRiskIndex 2016: Reveals the Necessity for Regional Cooperation in Vulnerability Reduction. *Journal of Extreme Events*, Vol. 3, No. 1 1650005 (21 pages) DOI: 10.1142/S2345737616500056 www.worldscientific.com
- Birkmann, J. Agboola, J. I., Welle, T., Aho, M., Odunuga, S., von Streit, J. & Pelling, M. (2017). Vulnerability, Resilience and Transformation of Urban Areas in the Coastal Megacity Lagos: Findings of Local Assessments and a Household Survey in Highly Exposed Areas. *J Extreme Events*, Vol. 3, No. 3 1650019 (24 pages) DOI: 10.1142/S2345737616500196. www.worldscientific.com
- Birkmann, J. (Ed.). (2013). *Measuring Vulnerability to Natural Hazards: Towards a Disaster Resilient Societies*, United Nations University, Tokyo.
- Brooks. N., Aure. E., & Whiteside, M. (2014): *Assessing the impact of ICF programmes on household and community resilience to climate variability and climate change*. Evidence on demand.
- Brown, O. (2008). *Migration and Climate Change*. International Organization for Migration ISSN 1607-338X. <http://www.iom.int>

- Burrows, K. & Kinney, P. L. (2016). Exploring the Climate Change, Migration and Conflict Nexus. *Int. J. Environ. Res. Public Health* 13, 443; doi:10.3390/ijerph13040443
www.mdpi.com/journal/ijerph
- Campbell, J., Oakes, R., and Milan, A. (2016). *Nauru: Climate change and migration – Relationships between household vulnerability, human mobility and climate change*. Report No.19. Bonn: United Nations University Institute for Environment and Human Security (UNU-EHS).
- Dasgupta, P., J.F. Morton, D. Dodman, B. Karapinar, F. Meza, M.G. Rivera-Ferre, A. Toure Sarr, and K.E. Vincent, (2014): *Rural areas*. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects*. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 613-657.
- Dev, S. M. (2011). Climate Change, Rural Livelihoods and Agriculture (focus on Food Security) in Asia-Pacific Region. *Indira Gandhi Institute of Development Research*, Mumbai
<http://www.igidr.ac.in/pdf/publication/WP-2011-014.pdf>
- DFID, (2004). The impact of climate change on the vulnerability of the poor. *Department for International Development*.
- Dube, T, & Phiri, K. (2013). Rural Livelihoods under Stress: The Impact of Climate Change on Livelihoods in South Western Zimbabwe. *American International Journal of Contemporary Research*. Vol. 3 No. 5. www.aijcrnet.com Zimbabwe.
- Duwal, P. (2015). Perceived Impacts of Climate Change on Forests and Livelihoods in the Padampokhari Village on the Parsa Wildlife Reserve Buffer Zone, Nepal. A thesis submitted to University of Washington.
- Duwal, P. (2015). *Perceived Impacts of Climate Change on Forests and Livelihoods in the Padampokhari Village on the Parsa Wildlife Reserve Buffer Zone, Nepal*. A thesis submitted to University of Washington.
- Duwal, P. (2015). *Perceived Impacts of Climate Change on Forests and Livelihoods in the Padampokhari Village on the Parsa Wildlife Reserve Buffer Zone, Nepal*. A thesis submitted to University of Washington.
- Elasha, B. O. (2006). *Environmental Strategies to Increase Human Resilience to Climate Change: Lessons for Eastern and Northern Africa*. A Final Report Submitted to Assessments of Impacts and Adaptations to Climate Change (AIACC). International START. www.start.org

- FAO (2017). *Migration, Agriculture and Climate Change educing vulnerabilities and enhancing resilience*. Food and Agriculture Organization I8297EN/1/12.17. www.fao.org
- GAWU (2012). *Climate Change and its Impact on the Livelihood of Farmers and Agricultural Workers in Ghana*. GAWU. Ghana.
- Gentle, P., & Maraseni, T. N. (2012). Climate change, poverty and livelihoods: adaptation practices by rural mountain communities in Nepal. *Elsevier*. www.elsevier.com/locate/envsci 24 – 34.
- GLCA (2009). *Facilitating an International Agreement on Climate Change: Adaptation to Climate Change*. www.globalclimateaction.org
- Gyampoh, B. A., Asante, W. A., Douglas, J. L. R., Adu-Acheampong, G., Assimeng, T. & Gyamfi, A. O. (2011). Mapping and documenting indigenous knowledge in climate change adaptation in Ghana.
- Hossain, A., Reza, I., Rahman, S. & Kayes, I. (2012). Climate Change and its Impacts on the Livelihoods of the Vulnerable People in the Southwestern Coastal Zone in Bangladesh. *ResearchGate* <https://www.researchgate.net/publication/226923239> DOI: 10.1007/978-3-642-22266-5_15.
- Huq, N., Hugé, J., Boon, E., & Gain, A. K. (2015). Climate Change Impacts in Agricultural Communities in Rural Areas of Coastal Bangladesh: A Tale of Many Stories. *Sustainability* 7, 8437-8460; doi:10.3390/su7078437 ISSN 2071-1050 www.mdpi.com/journal/sustainability
- ILG (2010). *Understanding the basics of Land Use and Planning*. Institute for Local Government. www.ca-ilg.org California.
- Institute of Green Growth Solutions (2015). *Climate Change Learning Strategy in Ghana: Background Report*. Institute of Green Growth Solutions
- International Organization for Migration (IOM) (2009). *Migration, Environment and Climate Change: Assessing the Evidence*. ISBN 978-92-9068-454-1. <http://www.iom.int> Switzerland.
- Jiménez Cisneros, B.E., T. Oki, N.W. Arnell, G. Benito, J.G. Cogley, P. Döll, T. Jiang, and S.S. Mwakalila, (2014). *Freshwater resources*. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects*. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 229-269.
- Jørstad. H., & Webersik, C. (2016). Vulnerability to climate change and adaptation strategies of local communities in Malawi: experiences of women fish-processing groups in the Lake Chilwa Basin.

Earth System. Dynamics., 7, 977–989, www.earth-syst-dynam.net/7/977/2016/ doi:10.5194/esd-7-977-2016

Jørstad, H., & Webersik, C. (2016). Vulnerability to climate change and adaptation strategies of local communities in Malawi: experiences of women fish-processing groups in the Lake Chilwa Basin. *Earth System. Dynamics.*, 7, 977–989, www.earth-syst-dynam.net/7/977/2016/ doi:10.5194/esd-7-977-2016

Klein, R. J. T., Kartha, S., Persson, A., Watkiss, P., Ackerman, F., Downing, T. E., Kjellén, B., & Schipper, L. (2008). *Adaptation: Needs, Financing and Institutions*. www.breakingtheclimatedeadlock.com breaking the Climate Deadlock

Kong'ani, L. N. S. (2016). *Relationship between Community Livelihood Options and Climate Change Knowledge and Practices: A Case Study of Maasai Mau Forest, Narok County, Kenya*. A Thesis submitted to the University of Nairobi. Nairobi.

Kudjey, A. A. (2014). Climate Change, Migration and Development in Ghana. DOI: 10.13140/RG.2.2.32498.71363 <https://www.researchgate.net/publication/312607139>

Martin, S. F. (2010). *Climate Change and Migration*. German Marshall Fund of the United States.

Mbaye, L. M. (2017). *Climate change, natural disasters, and migration*. IZA World of Labor.

MEFCC & GIZ. (2014). *A Framework for Climate Vulnerability Assessment*, Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH, CCA AI.

http://www.adaptationcommunity.net/?wpfb_dl=236

Olsson, L., M. Opondo, P. Tschakert, A. Agrawal, S.H. Eriksen, S. Ma, L.N. Perch, and S.A. Zakieldean, (2014): *Livelihoods and poverty*. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects*. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 793-832.

Olsson, L., M. Opondo, P. Tschakert, A. Agrawal, S.H. Eriksen, S. Ma, L.N. Perch, and S.A. Zakieldean, 2014: Livelihoods and poverty. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects*. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)].

- Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 793-832.
- Panneerselvam R. (2011). *Research Methodology*. PHI Learning Private Ltd. New Delhi.
- Peprah, K. (2014). Urban Sprawl of Wa, Ghana: Socio-Economic Implications for Small-Holder Farmers. *International Journal of Innovative Research & Development*, 3(1): 277-288.
- Piguet, E., Pécoud, A. & Guchteneire, P. d. (2011). *Migration and Climate Change: An Overview*. Published in Refugee Survey Quarterly 33, issue 3, 1-23.
- Porter, J.R., L. Xie, A.J. Challinor, K. Cochrane, S.M. Howden, M.M. Iqbal, D.B. Lobell, and M.I. Travasso. (2014). *Food security and food production systems*. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects*. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 485-533.
- Rademacher-Schulz, C. & Mahama, E. S. (2012). *"Where the Rain Falls" Project Case study: Ghana Results from Nadowli District, Upper West Region*. United Nations University Institute for environment and human security (UNU-EHS).
- Revi, A., D.E. Satterthwaite, F. Aragón-Durand, J. Corfee-Morlot, R.B.R. Kiunsi, M. Pelling, D.C. Roberts, and W. Solecki, (2014): *Urban areas*. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects*. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 535-612.
- Rigaud K. K., Sherbinin. A. d., Jones, B., Bergmann. J., Clement, V., Ober, K., Schewe, J., Adamo, S., McCusker. B., Heuser, S. & Midgley, A. (2018). *Preparing For Internal Climate Migration*. www.worldbank.org Washington.
- Selvaraju, R., Subbiah, A.R., Baas S. & Juergens, I. (2006). Livelihood adaptation to climate variability and change in drought-prone areas of Bangladesh Developing institutions and options. *Institutions for Rural Development*. FAO. ISBN 978-92-5-105602-8. ISSN 1817-4418 Rome.
- Senbeta, A. F. (2009). *Climate Change Impact on Livelihood, Vulnerability and Coping Mechanisms: A Case Study of West-Arsi Zone, Ethiopia*. Thesis Submitted to Lund University Master's Program in Environmental Studies and Sustainability Science.

- Stapleton, S. O., Nadin, R., Watson, C. & Kellett, J. (2017). *Climate change, migration and displacement. The need for a risk-informed and coherent approach*. Overseas Development Institute. www.odi.org London.
- Tacoli, C. (2011). Climate Change and Migration Study of the climate adaptation-migration nexus and the role for development cooperation. GIZ. www.giz.de
- Trabacchi, C., & Mazza F. (2015). *Emerging solutions to drive private investment in climate resilience*. Climate Policy Initiative (CPI). www.climatepolicyinitiative.org
- UNDP, (2011). *Wa Municipal Assembly Human Development Report 2011*. United Nations Development Programme Ghana Office Accra.
- UNEP (2011). *Livelihood Security Climate Change, Migration and Conflict in the Sahel*. www.unep.org/conflictsanddisasters ISBN: 978-92-807-3198-9.
- UNEP (2011). *Livelihood Security Climate Change, Migration and Conflict in the Sahel*. www.unep.org/conflictsanddisasters ISBN: 978-92-807-3198-9.
- Vorsah, R. V., (2015). *Climate change effects on smallholder farmers' livelihoods: the case of municipal of the Ashanti region of Ghana*. Thesis Submitted To the University Of Ghana, Legon. <http://ugspace.ug.edu.gh> University of Ghana.
- Waldinger, M. & Fankhauser, S. (2015). Climate change and migration in developing countries: evidence and implications for PRISE countries. *Grantham Research Institute on Climate Change and the Environment*. www.lse.ac.uk/GranthamInstitute
- WFP (2015). Climate change in Afghanistan What does it mean for rural livelihoods and food security. www.wfp.org
- Williams, R. A. (2000). *Environmental Planning For Sustainable Urban Development*. Caribbean Water and Wastewater Association 9th Annual Conference & Exhibition at Chaguaramas, Trinidad.
- World Bank (2010). *World development report2010 Development and Climate Change*. www.worldbank.org ISBN: 978-0-8213-7987-5 ISSN: 0163-5085 e-ISBN: 978-0-8213- 988-2 DOI: 10.1596/978-0-8213-7987-5 Washington.
- WorldRiskReport (2014). *The city as a risk area*. www.WorldRiskReport.org

APPENDICES

Universität Stuttgart, Germany

Questionnaire for households within the hinterland

I am currently a student of the above university, pursuing an International Master’s Degree in Infrastructure Planning. I am conducting a Thesis on the Topic “**Assessment of Vulnerability and Climate Risks in Wa City Region with Special Focus on Urban-Rural Linkages**”. I therefore humbly request the following data in support of the above subject. The purpose is strictly academic. Thank you.

Background

Questionnaire administrator.....

Date

Household

- 1. Name of Household head.....
- 2. Gender: Male [] Female []
- 3. Household Size.....
- 4. Source of Livelihood
- 5. Age.....

Information

- 6. Do you think that the climate keeps varying in recent times? Yes [] No []
 - a. If yes, has it affected your life? Yes [] No []
 - b. Have you received any information/education on how to adapt to the changing conditions? Yes [] No []
 - c. Are you taking any measure against the risk of climate change? Yes [] No []
 - d. If yes, what are/is these measures?
 - e. Do you feel your livelihood is being threaten? Yes [] No []
 - f. If you have no information about climate change, how do you intend to find out?
.....
 - g. If you receive education today, would you modify your livelihood and the way you treat the environment? Yes [] No []

Livelihood

- 7. What is your source of livelihood?
- 8. Have you recorded any loses in the last ten years? Yes [] No []
- 9. Is it sufficient for your family? Yes [] No []
- 10. Did you change your occupation? Yes [] No []
- 11. Do you feel climate variability has affected your livelihood? Yes [] No []

Migration

- 12. Have you migrated in the last ten years? Yes [] No []
 - a. If yes from where?
 - b. What was the reason for the movement?
 - c. Are you satisfied in your current community?
 - d. Would you move again if your current circumstances change? Yes [] No []
 - e. If no, what is the reason?
 - f. Would you like to move to the city? Yes [] No []

Family

- 13. Do you have family or relations in the city? Yes [] No []
 - a. If yes, do you receive remittances from them? Yes [] No []
 - b. Do you feel they have better conditions than you? Yes? [] No []
 - c. Are you satisfied with your current circumstances? Yes? [] No []
 - d. Would you like to join them in the city? Yes? [] No []
 - e. Do you wish you were in the city? Yes? [] No []

Farming

- 14. Are you into farming? Yes [] No []
 - a. If yes, what has been your performance (crop yield)?
.....
 - b. What account for your current crop performance?
.....
.....
 - c. Are you happy with your current crop performance? Yes [] No []

- d. Do you attribute your crop performance to climatic conditions? Yes [] No []
- e. If your crop yield continues to decline, would you migrate to the city? Yes [] No []
- f. Or would you adapt to different methods? Yes [] No []
- g. If you would adapt to different methods, what are these?

.....

15. Do you also rear animals? Yes [] No []

- a. If yes, what has been the performance?
-

Resources

16. Do you share some resources with inhabitants in the city? Yes [] No []

- a. If yes, what are these resources?
- b. How are these resources shared?
- c. How are these resources utilized ?.....
- d. Are these resources still available? Yes [] No []
- e. How long do you think these resources can last?
- f. What is your primary source of energy?
- g. Do you plant trees? Yes [] No []

Institutions

17. Do you receive information from any institution regarding climate change? Yes [] No []

18. If yes, which institution?

19. What are the information provided?

20. Do you rely only on this information? Yes [] No []

Income

21. What is your current monthly income?

Education

22. What is your level of education? No Education [] Primary [] Second Cycle [] Tertiary []

23.

Universität Stuttgart, Germany

Questionnaire for households within the city

I am currently a student of the above university, pursuing an International Master’s Degree in Infrastructure Planning. I am conducting a Thesis on the Topic “**Assessment of Vulnerability and Climate Risks in Wa City Region with Special Focus on Urban-Rural Linkages**”. I therefore humbly request the following data in support of the above subject. The purpose is strictly academic. Thank you.

Background

Questionnaire administrator.....

Date.....

Household

24. Name of Household head.....

25. Gender: Male [] Female []

26. Household Size.....

27. Source of Livelihood.....

28. Age.....

Information/Awareness

29. Do you think that the climate keeps varying in recent times? Yes [] No []

h. If yes, has it affected your life? Yes [] No []

i. Have you received any information/education on how to adapt to the changing conditions? Yes [] No []

j. Are you taking any measure against the risk of climate change? Yes [] No []

k. If yes, what are/is these measures?.....

l. Do you feel your livelihood is being threaten? Yes [] No []

m. If you have no information about climate change, how do you intend to find out?.....

n. If you receive education today, would you make or modify your livelihood and the way you treat the environment? Yes [] No []

Livelihood

- 30. What is your source of livelihood?
- 31. Is it sufficient for your family? Yes [] No []
- 32. Did you change your occupation? Yes [] No []
- 33. Is your occupation sustainable? Yes [] No []
- 34. Has climate change affected your livelihood? Yes [] No []

Migration

- 35. Have you migrated in the last ten years? Yes [] No []
 - g. If yes from where?.....
 - h. What was the reason for the movement?.....
 - i. Are you satisfied in your current community?.....
 - j. Would you move again if your current circumstances change? Yes [] No []
 - k. If no, what is the reason?.....
 - l. Would you like to move to the hinterland? Yes [] No []

Family

- 36. Do you have family or relations in the hinterland? Yes [] No []
 - f. If yes, do you send remittances to them? Yes [] No []
 - g. Do you feel they have poorer conditions and less opportunities than you? Yes [] No []
 - h. Are you satisfied with your current circumstances? Yes [] No []
 - i. Would you like to join them in the hinterland? Yes [] No []
 - j. Would you move to the hinterland if your current circumstances change? Yes [] No []

Farming

- 37. Are you into farming? Yes [] No []
 - h. If yes, what has been your performance (crop yield)?
 -
 - i. What account for your current crop performance?
 -
 -
 - j. Are you happy with your current crop performance? Yes [] No []

- k. Do you attribute your crop performance to climatic conditions? Yes [] No []
- l. If your crop yield continues to decline, would you migrate to the city? Yes [] No []
- m. Or would you adapt to different methods? Yes [] No []
- n. If you would adapt to different methods, what are these?

.....

38. Do you also rear animals? Yes [] No []

- b. If yes, what has been the performance?

Resources

39. Do you share some resources with the hinterland? Yes [] No []

- h. If yes, what are these resources?
- i. How are these resources shared?.....
- j. How are these resources utilized?.....
- k. Are these resources still available? Yes [] No []
- l. How long do you think these resources can last?.....

Institutions

- 40. Do you receive information from any institution regarding climate change? Yes [] No []
- 41. If yes, which institution?
- 42. What are these information?
- 43. Do you rely only on this information? Yes [] No []

Income

44. What is your current monthly income?.....

Education

45. What is your level of education? No Education [] Primary [] Second Cycle [] Tertiary []

Universität Stuttgart, Germany

Questionnaire for the Wa Municipal Assembly

I am currently a student of the above university, pursuing an International Master’s Degree in Infrastructure Planning. I am conducting a Thesis on the Topic “**Assessment of Vulnerability and Climate Risks in Wa City Region with Special Focus on Urban-Rural Linkages**”. I therefore humbly request the following data in support of the above subject. The purpose is strictly academic. Thank you.

Background

- 46. Name of Institution.....
- 47. Name of Respondent (Optional).....
- 48. Position Gender: Male [] Female []
- 49. Phone Number.....
- 50. Email Address.....
- 51. What is your mandate?
.....
.....
.....
.....
.....

Responsibilities

- 52. What are your roles in combating climate change?
- 53. In which ways are you carrying out this mandate?
- 54. Do you have climate change action plan? Yes [] No []
 - a. If yes, what is the scope and level of implementation over the past ten years?
.....
.....
 - b. If no, what are the reasons?
.....
.....
- 55. Do you incorporate climate change issues in you medium term planning? Yes [] No []

a. If no, how do you make up for the shortfall?

.....
.....

56. Are you well resourced? Yes [] No []

If No, what are the challenges?

.....
.....
.....

57. Do you have adequate technical capacity in dealing with climate change issues? Yes []

No []

Resources

58. Do the farmers have adequate land resources in the municipality? Yes [] No []

59. What account for the current situation?

.....
.....

60. Does the current land use management regime in tandem with your climate change goals?

Boosting Resilience

61. What is the level of awareness of climate change issues among inhabitants?

62. What are you doing specifically to boost resilient, and help inhabitants adapt to the changing conditions

.....
.....
.....

63. In which ways are you contributing to raise awareness?.....

.....
.....

Universität Stuttgart, Germany

Questionnaire for the Municipal Agricultural Development Unit

I am currently a student of the above university, pursuing an International Master’s Degree in Infrastructure Planning. I am conducting a Thesis on the Topic“**Assessment of Vulnerability and Climate Risks in Wa City Region with Special Focus on Urban-Rural Linkages**”. I therefore humbly request the following data in support of the above subject. The purpose is strictly academic. Thank you.

Background

- 64. Name of Institution.....
- 65. Name of Respondent (Optional).....
- 66. Position Gender: Male [] Female []
- 67. Phone Number.....
- 68. Email Address.....
- 69. What is your mandate?
.....
.....
.....
.....
.....

Responsibilities

- 70. What are your roles in combating climate change?
- 71. In which ways are you carrying out this mandate?
- 72. Are you well resourced? Yes [] No []

If No, what are the challenges?
.....
.....
.....
- 73. Do you have the technical capacity?

74. What has been the performance of farmers in terms of crop yield within the past ten years? Please fill in the table

Year	Crop	Average yield/ton	Remarks

Resources

75. Do the farmers have adequate land resources? Yes [] No []

76. What are the current soil characteristics vis-a-vis the last ten years?

.....

77. Does the current soil characteristics still support farming in the communities? Yes [] No []

78. What is the level of drought occurrence within the last ten years?

Boosting Resilience

1. What is the level of awareness among the farmers on climate variability?
2. What projects are you undertaking to help build resilience?

.....
.....
.....

3. In which ways are you contributing to raise awareness and help farmer households adapt to the changing conditions?

.....
.....
.....

Universität Stuttgart, Germany

Questionnaire for the Environmental Protection Agency (EPA)

I am currently a student of the above university, pursuing an International Master’s Degree in Infrastructure Planning. I am conducting a Thesis on the Topic “**Assessment of Vulnerability and Climate Risks in Wa City Region with Special Focus on Urban-Rural Linkages**”. I therefore humbly request the following data in support of the above subject. The purpose is strictly academic. Thank you.

Background

- 79. Name of Institution.....
- 80. Name of Respondent (Optional).....
- 81. Position Gender: Male [] Female []
- 82. Phone Number.....
- 83. Email Address.....
- 84. What is your mandate?
.....
.....
.....
.....
.....

Responsibilities

- 85. What are your roles in combating climate change?
- 86. In which ways are you carrying out this mandate?
- 87. Do you incorporate climate change issues in your environmental management? Yes []
No []
 - c. If yes, how is it done?
.....
.....
 - d. If no, what are the reasons
.....
.....

88. Are you well resourced? Yes [] No []

If No, what are the challenges?

.....
.....
.....

89. Do you have adequate technical capacity in dealing with climate change issues? Yes []
No []

90. Do you have an action plan for climate change adaptation?

Resources

91. Are there adequate lands and other natural resources? Yes [] No []

92. How are they being managed?

.....
.....

93. What is the level of environmental degradation?

.....
.....

Boosting Resilience

94. What is your role in educating the inhabitants on issues of climate change variability

.....
.....

95. In which ways are you contributing to raise awareness?

.....
.....

96. Do you have specific projects towards climate change adaptation? Yes [] No []

97. If yes, what are these projects and their objectives?

Universität Stuttgart, Germany

Questionnaire for the Forest Services Commission (FSC)

I am currently a student of the above university, pursuing an International Master’s Degree in Infrastructure Planning. I am conducting a Thesis on the Topic **Assessment of Vulnerability and Climate Risks in Wa City Region with Special Focus on Urban-Rural Linkages**”. I therefore humbly request the following data in support of the above subject. The purpose is strictly academic. Thank you.

Background

- 1. Name of Institution.....
- 2. Name of Respondent (Optional).....
- 3. Position Gender: Male [] Female []
- 4. Phone Number.....
- 5. Email Address.....
- 6. What is your mandate?
.....
.....
.....
.....
.....

Information Dissemination

- 7. What are your roles in combating climate change?
.....
.....
- 8. In which ways are you carrying out this mandate?
.....
- 9. Are you well resourced? Yes [] No []

If No, what are the challenges?

.....
.....
.....

10. Do you have the technical capacity? Yes [] No []

11. If no, what are doing to make up for the shortfall?

.....

12. How do you disseminate the information to the inhabitants?

Role of the Institution in Boosting Resilience

13. Do you play any specific role in educating the inhabitants on issues of climate change variability?

14. Do you incorporate climate change activities in your forest management?

15. How do you do it?

.....
.....

16. Do you have a climate change action plan? Yes [] No []

17. Do you have specific projects meant to mitigate the adverse impacts of climate change?
Yes [] No []

18. If yes, what is/are these projects and their objectives?

.....
.....

Universität Stuttgart, Germany

Questionnaire for the Town and Country-Planning Department (TCPD)

I am currently a student of the above university, pursuing an International Master’s Degree in Infrastructure Planning. I am conducting a Thesis on the Topic “**Assessment of Vulnerability and Climate Risks in Wa City Region with Special Focus on Urban-Rural Linkages**”. I therefore humbly request the following data in support of the above subject. The purpose is strictly academic. Thank you.

Background

- 98. Name of Institution.....
- 99. Name of Respondent (Optional).....
- 100. Position Gender: Male []
Female []
- 101. Phone Number.....
- 102. Email Address.....
- 103. What is your mandate?
.....
.....
.....
.....
.....

Responsibilities

- 104. What are your roles in combating climate change?
- 105. In which ways are you carrying out this mandate?
- 106. Do you incorporate climate change issues in your planning? Yes [] No []
 - e. If yes, how is it done?
.....
.....
 - f. If no, what are the reasons
.....
.....

107. Are you well resourced? Yes [] No []

108. If No, what are the challenges?

.....
.....
.....

109. Do you have adequate technical capacity in dealing with climate change issues?
Yes [] No []

110. Do you have a climate change action plan? Yes [] No []

Resources

111. Are there adequate lands for farming purposes? Yes [] No []

112. If no, what account for the shortfall?

.....
.....

Boosting Resilience

113. What is your role in educating the inhabitants on issues of climate change variability?

.....
.....

114. In which ways are you contributing to raise awareness?

.....
.....

115. Do you have specific project to help mitigate the adverse impacts of climate change? Yes [] No []

116. If yes, what is/are these projects and their objectives?

IMAGES FROM FIELD SURVEY, JUNE 2018.

An interaction with Women groups in Chansa and Nyagli



Source: Field Survey (June, 2018)



Source: Field Survey (June, 2018)



Source: Field Survey (June, 2018)



Source: Field Survey (June, 2018)



Source: Field Survey (June, 2018)

An Interaction with Some Household Heads



Source: Field Survey (June, 2018)