

**MAINSTREAMING CLIMATE CHANGE ADAPTATION INTO
DEVELOPMENT PLANNING FOR SUSTAINABLE DEVELOPMENT IN THE
KASSENAN-NANKANA WEST DISTRICT**

By

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DECLARATION

I hereby declare that this work for the award of MSc. Development Planning and Management is solely the product of my efforts. To the best of my knowledge, the work contains neither materials previously published by any author nor materials submitted and accepted for the award of any degree by any university except where acknowledgement has been duly made.

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ABSTRACT

It is argued that climate change is the greatest contemporary global threat to sustainable development, and that the risks associated with climate change will become more severe over time. In Ghana, climate change has threatened the lives and livelihoods of people particularly in the three regions of the north. Despite this, adaptation to climate change which is fundamental for sustainable development has long been viewed to be far away from the immediate concerns of development and therefore not incorporated into poverty reduction programmes across the country.

In order to address the daunting challenges posed by climate change, central and local authorities need to undertake planned adaptation and integrate climate change in development planning in order to reduce the vulnerability of the poor. In this regard, the study sought to examine the extent to which climate change adaptation has been mainstreamed into development planning in the Kassena-Nankana West District. The study adopted the qualitative approach involving the use of in-depth interviews, focus group discussions and observation.

The study found that, whereas the level of vulnerability to climate change in the District was high, adaptive capacity was low. Initiatives in the District were in response to environmental challenges rather than climate change hazards or impacts. As a result, the District's approach to fighting climate change was reactive. Mainstreaming was ineffective both at the district and sub-district level. The District had no strategy for addressing climate change and the understanding and capacity of decentralized departments/agencies about climate change was low. A number of challenges accounted for the poor mainstreaming of climate change in Kassena-Nankana West District. These include limited knowledge on climate change risks and disaster preparedness, the neglect of indigenous knowledge and weak institutional capacity among others. Some of the prospects for mainstreaming climate change adaptation in the District include the wealth of unexploited indigenous knowledge on climate change adaptation and the non-institutionalization of climate change in the District. Therefore, the study recommends that, climate change adaptation should be institutionalized within the structures of the Assembly and indigenous knowledge on adaptation should be given priority attention.

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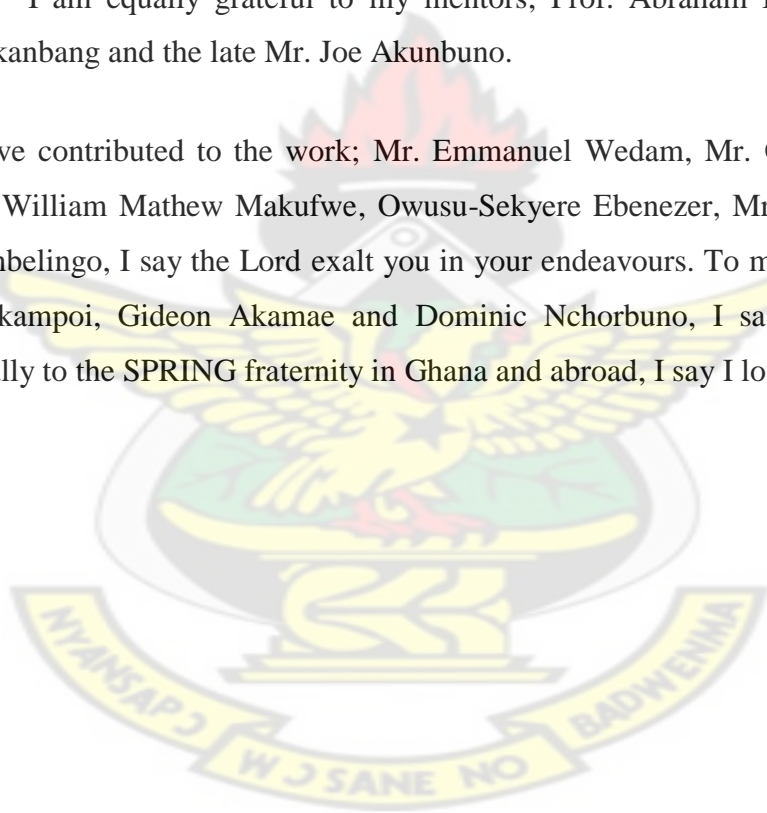


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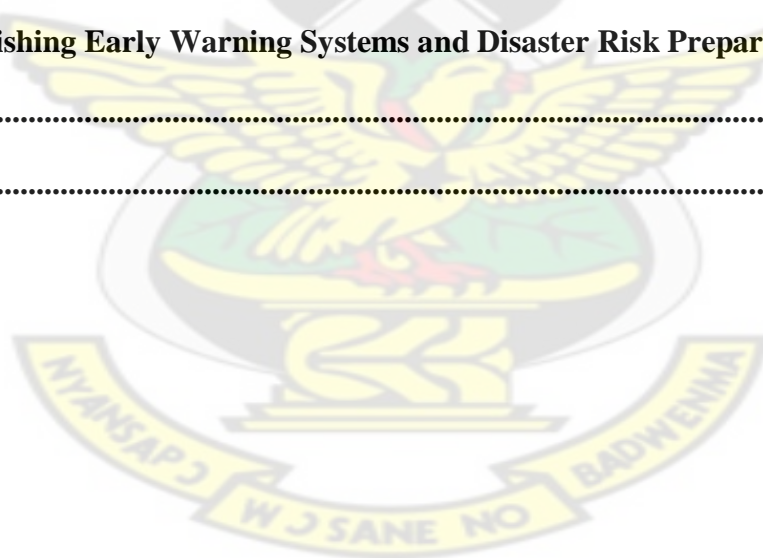
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LIST OF ACRONYMS

AAP	Africa Adaptation Programme
AAP	Africa Adaptation Programme
ADB	Asian Development Bank
AfDB	African Development Bank
ALP	Adaptation Learning Programme
CARE	Cooperative for Assistance and Relief Everywhere
CBOs	Community-Based Organizations
CC-DARE	Climate Change Adaptation and Development Programme Initiative
DADU	District Agricultural Development Unit
DBO	District Budget Officer
DCD	District Coordinating Director
DFO	District Finance Officer
DMTDP	District Medium Term Development Plan
DPCU	District Planning and Coordinating Unit
DPO	District Planning Officer
EACC	Economics of Adaptation to Climate Change
EPA	Environmental Protection Agency
ESU	Environmental Sanitation Unit
FGDs	Focus Group Discussions
GES	Ghana Education Service
GHS	Ghana Health Service
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GPRS I	Ghana Poverty Reduction Strategy
GPRS II	Growth and Poverty Reduction Strategy
GSGDA	Ghana Shared Growth and Development Agenda
GSGDA	Ghana Shared Growth and Development Agenda
IDA	International Development Association
IDIIs	In-depth interviews
IPCC	Inter-Governmental Panel on Climate Change
MDA	Ministries, Departments and Agencies

MDGs	Millennium Development Goals
MEST	Ministry of Environment, Science and Technology
MMDAs	Metropolitan, Municipal and District Assemblies
MOFA	Ministry of Food and Agriculture
MoFEP	Ministry of Finance and Economic Planning
NADMO	National Disaster Management Organization
NAPA	National Adaptation Programmes of Action
NCAP	Netherlands Climate Assistance Programme
NCCC	National Climate Change Committee
NCCPF	National Climate Change Policy Framework
NCCPF	National Climate Change Policy Framework
NCCSAP	Netherlands Climate Change Study Assistance Programme
NDPC	National Development Planning Commission
NGOs	Non-Governmental Organizations
NIC	National Insurance Commission
NIC	National Insurance Commission
NREG	Natural Resources and Environmental Governance
NREG	Natural Resources and Environmental Governance Programme
ODA	Official Development Assistance
OECD	Organization for Economic Cooperation and Development
PAS	Policy Advice Series
PRA	Participatory Rural Appraisal
RCC	Regional Coordinating Council
SADA	Savannah Accelerated Development Authority
SEA	Strategic Environmental Assessment
TAR	Third Assessment Report
TCPD	Town and Country Planning Department
TERI	The Energy and Resources Institute
UKCIP	United Kingdom Climate Impact Programme
US-EPA	United States – Environmental Protection Agency
UNDP	United Nations Development Programme

UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollars

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CHAPTER ONE

CLIMATE CHANGE ADAPTATION AND DEVELOPMENT PLANNING – KEY ISSUES AND CHALLENGES

1.1 Introduction

It is argued that climate change is the greatest contemporary global threat to sustainable development, and that the risks associated with climate change will become more severe over time. Studies by Minia (2004, as cited in Yaro, 2010) and The World Bank Group (2011) have indicated significant changes in the climate of Ghana and projected an apocalyptic future for the country. For instance, between 1960 and 2003, the mean annual temperature increased by 1.0°C, at an average rate of 0.21°C per decade with the rate of increase being higher in the northern regions (The World Bank Group, 2011: 4). Within the same period also, the average number of hot days and hot nights per year increased by 48 and 73 respectively (The World Bank Group, 2011: 4). Similarly, the average number of cold days and cold nights per year decreased by 12 and 18.5 respectively and with decreasing trend and highly variable rainfall pattern in inter-annual and inter-decadal timescales in the period (The World Bank Group, 2011: 4).

Projections for the future indicate that, for the three regions of the North, temperature is projected to increase by 2.1–2.4°C and total annual rainfall is projected to decline by 1.1%, and 20.5% in 2020 and 2080, respectively (The World Bank Group, 2011: 4). These changes will preponderantly affect the lives and livelihoods of most Ghanaians particularly the poor.

To address the daunting challenges posed by climate change, the UNFCCC (2007) and the IPCC (2007) has proposed a two-tier solution: mitigation and adaptation. Mitigation involves the efforts aimed at slowing/stopping or even reversing the climate change phenomenon by tackling the prime causes of climate change such as cutting greenhouse gas emissions. Adaptation on the other hand, is based on the notion that, due to past and present emissions, some degree of climate change is inevitable and therefore measures will be needed to adapt to it (IPCC, 2007:19; OECD, 2008; Muriuki, 2011).

Adaptation to climate change refers to adjustments in natural or human systems in response to actual or expected climatic stimuli or their effects, which reduces harm or exploits advantageous

opportunities (IPCC, 2007:6). A system's adaptation to climate change is largely influenced by its vulnerability, which is a function of the system's exposure, sensitivity, and adaptive capacity (Easterling, Hurd and Smith, 2004:3; Nelson and Agbey, 2005:19; Dazé, Ambrose and Ehrhart, 2009).

The exposure of a system to climate change is the extent to which elements of a climate-sensitive system are in contact with climate change phenomenon. For instance, those living in arid/semi-arid regions of Ghana and low-lying coastal areas or river basins are likely to increase their exposure to drought, floods, storms and coastal erosion. Sensitivity to climate change on the other hand, is the degree to which a system (community) is affected by climatic stresses. For instance, a community dependent on rain-fed agriculture is much more sensitive than one where the main livelihood source is mining. Also, in crop farming, maize is more sensitive to climate change because, it is less resistant to changes in precipitation than a crop like cassava. Adaptive capacity is the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (IPCC, 2001a). Adaptive capacity can be spontaneous, reactive, planned, proactive or anticipatory.

The adaptive capacity of individuals, households and communities is shaped by the interplay of factors relating to access to and control over natural, human, social, physical and financial resources (Dazé, Ambrose and Ehrhart, 2009:5). In addition, wealth, availability of technology, appropriate decision-making capabilities, risk spreading (e.g., insurance), ability to manage information, and the perceived attribution of the source of stress contribute significantly to adaptive capacity and the capability of social and ecological systems to actively and adequately respond to climate change (Easterling, Hurd and Smith, 2004). The access to and control over these resources required for adaptation to climate change differs within countries, communities and households and are influenced by policies and power structures (Dazé, Ambrose and Ehrhart, 2009:3).

The world's poorest people are the worst victims of climate change because they lack the resources to adapt (Nelson and Agbey, 2005). In Ghana, climate change assessments indicate that vulnerability to climate change is highest in the poverty stricken ecological zones - the

coastal and northern savannah zones (Nelson and Agbey, 2005; Yaro, 2010, The World Bank Group; 2011; Inkoom, 2011; Stanturf, et al, 2011). Albeit, poverty levels in Ghana have reduced significantly, overall poverty levels still remain high in the three regions of the north, at about fifty-nine percent (59%). Specifically, the proportion of people living in poverty in the Upper West Region is 88%, Upper East Region with 70% and Northern Region, 52 % (Ghana Statistical Service, 2007: 13). The high incidence of poverty in the north has been attributed to long history of neglect, from the colonial to present governments (Songsore, 2011) as well as structural environmental scarcity resulting from climate change (Van der Geest and de Jeu, 2008; Van der Geest, 2011).

It has been observed that poverty and climate change are intricately related (Nelson and Agbey, 2005; Inkoom, 2011). Yet adaptation to climate change which is fundamental for poverty reduction and sustainable development has long been viewed to be far away from the immediate concerns of development discourse and therefore not incorporated into poverty reduction programmes across the country (Nelson and Agbey, 2005). In order to address the daunting challenges posed by climate change, policy design and implementation processes need cautious and collaborative crafting that respond to the needs of vulnerable groups. Local and national policies and institutions can play a critical role in shaping people's capacity to adapt to climate change (Kelly and Adger, 2000:330; Dazé, Ambrose and Ehrhart, 2009:3). Nelson and Agbey, (2005) and others such as Banuri and Gupta (2000), and Robinson and Herbert (2001) have acknowledged that the improvement of adaptive capacity is a necessary condition for reducing vulnerability, particularly for the most vulnerable regions, district assemblies, and socio-economic groups. To them, the strategies required for the enhancement of adaptive capacity are essentially equivalent to those promoting sustainable development.

Therefore, integrating climate change adaptation into development policies, plans, programmes, projects and budgets can minimize the likelihood of climate change undermining or negating the effectiveness and sustainability of development interventions (AfDB *et al.* 2002; MEST, 2010). This is what CARE (2010) described as climate-proofing – making development plans climate change resilient. Mainstreaming climate change into development policies, plans and budgets will also ensure that development activities contribute to people's adaptive capacity, when

possible, and do not inadvertently increase their vulnerability to climate change (Füssel and Klein, 2004; CARE, 2010).

Easterling, Hurd and Smith (2004) have also suggested that central and local authorities should undertake planned adaptation and integrate this in development planning in order to reduce the vulnerability of the poor. Easterling, Hurd and Smith (2004) has identified two types of planned adaptations; reactive (undertaken in emergencies) and anticipatory (undertaken before impacts are apparent). Anticipatory adaptation can enhance people's capacities to cope with climate change by mainstreaming climate change into long-term decision-making. Furthermore, in order to increase the collective capacity of communities to adapt, there is the need to improve and strengthen human capital through education, outreach, and extension services and improve decision-making capacity at every level of human endeavour (Easterling, Hurd and Smith, 2004; Kok and de Coninck, 2007; UNFCCC, 2007).

Dietz et al (1999) observed that, the absence of incentives for adaptation to climate change at the household level in the Upper East Region and other parts of Northern Ghana has resulted in mal-adaptations. Similarly, studies by Gyasi et al (2006), Gyampoh, Idinoba and Amisah (2008) and most recently, Yaro (2010) as well as The World Bank Group (2011), have documented the impacts, coping strategies and adaptation to climate change in Ghana. However, as observed by Nelson and Agbey, (2005), climate change adaptation has not until recently, escaped the attention of planners and policy makers. In view of this, this study seeks to assess the extent to which climate change is being integrated into district development planning for sustainable development in Kassena-Nankana West District.

1.2 Statement of Research Problem

In Ghana, climate change is a threat to lives and livelihoods particularly the three regions of the north. In recent years, the three northern regions of Ghana have witnessed climate change stressors like, floods, storms and droughts which aggravated the already poverty situation in the area (MEST, 2010; Yaro, 2010; Würtenberger, Bunzeck and van Tilburg, 2011). For instance, the 2007 flood disaster in Northern Ghana killed 31 people, displaced 102, 208 persons and destroyed 7,152 hectares of farmlands, 45 schools, 39 dams, 542 km of feeder roads and 58 bridges and culverts in the Upper East Region alone (NADMO-UER, 2008). Again in 2010,

floods hit the Upper East Region destroying 3,877.9 hectares of farmland and 5,512 houses and displaced 34,553 persons (NADMO-UER, 2010). In the Kassena-Nankana West District, 14,874 people were displaced by the 2010 floods (NADMO-UER, 2010).

Despite these permeating impacts of climate change, efforts geared towards addressing climate Change in Ghana appear to be ad-hoc (reactive) as they are mainly driven by emergency and therefore hardly consider the long-term rippling implications (anticipatory adaptation) of climate change. Apparently, there is a need to properly plan and carefully adopt a development path that ensures climate resilience and integrates climate change adaptation measures into all facets of development planning.

The Government of Ghana in recognition of this has in recent times, taken steps to mainstream climate change into national development policies and plans. Examples of these efforts include the inclusion of climate change in the Ghana Shared Growth and Development Agenda (GSGDA) and the formulation of the National Climate Change Policy Framework (NCCPF) among others.

While these efforts aimed at integrating climate change into development policies and plans at the national level is widely acknowledged and applauded, it remains unclear how the local planning authorities are incorporating climate change adaptation issues into development planning. This study tries to identify and articulate in practical terms what has (or has not) been done by local governments and planning authorities (particularly the Kassena-Nankana West District) in addressing Climate Change adaptation, and what can be done to improve outcomes from this interface.

1.3 Research Questions

1.3.1 General Research Question

To what extent has climate change adaptation been mainstreamed into development planning in the Kassena-Nankana West District?

1.3.2 Specific Research Questions

1. What is the extent of vulnerability to climate change in Kassena-Nankana West District?

2. What climate change adaptation initiatives are pursued in the Kassena-Nankana West District?
3. To what extent are climate change adaptation initiatives in Kassena-Nanakana West District mainstreamed into development plans.
4. What are the challenges and prospects for mainstreaming climate change adaptation into development planning in Kassena-Nankana West District?

1.4 Research Objectives

1.4.1 General Research Objective

To examine the extent to which climate change adaptation has been mainstreamed into development planning in Kassena-Nankana West District.

1.4.2 Specific Research Objectives

1. To explore the extent of vulnerability to climate change in Kassena-Nankana West District.
2. To identify and assess climate change adaptation initiatives pursued in Kassena-Nankana West District.
3. To assess the extent to which climate change adaptation initiatives are mainstreamed into the development plans of Kassena-Nankana West District.
4. To discuss the challenges and prospects for mainstreaming climate change adaptation for sustainable development in Kassena-Nankana West District.

1.5 Scope and Delimitation of the Study

1.5.1 Geographical Scope of the Study

Kassena-Nankana West District was selected for this study. It is located in the North-eastern part of Ghana. The District lies within the climate risk guinea savannah ecological zone (Dietz et al 1999; The World Bank Group, 2011). The main economic activity in the district is subsistence (rain-fed) agriculture. The District also forms part of the Volta Basin and like most parts of Northern Ghana has witnessed droughts, floods and storms in recent times. These attributes of Kassena-Nankana West District made it the ideal place for the study of climate change adaptation issues.

1.5.2 Contextual Scope

Climate change adaptation is a vast academic field with diverse areas for academic and empirical analysis. However, this study deals with the mainstreaming of climate change adaptation into development planning at the district level in Ghana. In particular, the study examines the issues of vulnerability, adaptation initiatives and the extent of their integration into development planning as well as the challenges and prospects for doing so for the sustainable development of the Kassena-Nankana West District. Although, the impacts of climate change are varied and wide, this study due to its time and resource constraints focused on core livelihood indexes such as water availability for crop and animal requirement, institutional support and social infrastructure. These issues are of concern to the study because they are linked to the basic livelihood activity of the people which is agriculture.

The aim of this study was not to engage in detailed vulnerability and climate change impact analysis, but to explore them as a way of providing the basis for the analysis of the adaptation initiatives. Therefore, household and national level analysis of the phenomenon falls outside the limits of this study.

1.5.3 Time Reference for Data Collection

The reference period for data for the study was the past four (4) years starting from 2010 to 2013. This implies that development plans and budgets prepared under the GSGDA (2010 – 2013) were considered. The choice of this period was because the Kassena-Nankana West District was created in 2007 and had its first DMTDP only in 2010. Also, the time for the study, allowed for a snapshot review of climate change adaptation issues of concern.

1.6 Justification of the Study

Development is about increasing the availability of goods and services, access and opportunities, freedom and choices, and sustaining these gains over time (CARE, 2010). Climate change can undermine or even reverse the success and sustainability of development interventions. Climate change has been identified as a threat to the growth and development of Ghana and may erode recent gains in poverty reduction (MEST, 2010). Similarly, some development interventions can inadvertently leave people even more vulnerable than before to worsening droughts and floods,

changing rainfall patterns, sea-level rise and other impacts of climate change. On the contrary, well-designed development activities can increase people's resilience to these impacts. It is therefore, important to integrate or mainstream adaptation to climate change into development strategies, plans and programmes for sustainable development.

Mainstreaming climate change adaptation into development planning would provide protection to development investments and outcomes from the impacts of climate change, thus, increasing the sustainability of development interventions. In addition, the study would extend literature on climate change adaptation and development planning and thus, contribute to knowledge in that field. Similarly, the study may serve as a proposal to shape policy issues related to climate change adaptation and development planning in Ghana. The recommendations of the study may guide policy-makers in formulating policies aimed at increasing climate resilience and improving adaptive capacity of communities and districts to adapt to climate change in a sustainable manner. The study would also contribute to the on-going dialogue on climate change adaptation aimed at reducing vulnerabilities and increasing resilience to climate change.

1.7 Limitations of the study

The study used the case study approach which places emphasis on detail analysis but does not support the generalization of findings beyond the subjects of observation. The qualitative approach has also been criticized for researcher bias and subjectivity of which the researcher mitigated by carefully designing the research process and adopting methods, tools and techniques that meet the standards of empirical investigation in the social sciences. Also, the scope of the study has been narrowed to the analysis of the mainstreaming of climate change adaptation in development planning at the district level in Kassena-Nankana West District.

Similarly, issues such as climate change impacts and vulnerability are suitable for household level investigation where the real feelings and experiences of people could have been adequately captured. Due to this, the study had to rely on secondary data from reports and articles, and triangulated that with results from focus group discussions with area council members.

1.8 Organization of the Study

The study has been organized in five (5) distinct but inter-related chapters. The first chapter of the study consists of the general introduction, which deals with the background to climate change and development planning, the statement of the research problem, the research questions and objectives, scope of the study as well as the justification and limitation of the study.

Chapter two consists of the review of relevant literature pertaining to the study. In particular, the review includes the operationalization of key concepts, discussions of vulnerability, adaptation, climate change, the nexus between climate change adaptation and sustainable development, mainstreaming as a strategy for climate change adaptation, theoretical frameworks for mainstreaming climate change into development planning and finally the conceptual framework for analyzing the mainstreaming of climate change adaptation into development planning in Ghana. The review helped to identify gaps in the mainstreaming of adaptation processes at the national and sub-national levels for further analysis.

Chapter three is devoted to research methodology of the study. It begins with background information about the study area which is followed by a detail description of the research design, unit of analysis, key variables, sampling design, sample design/techniques, data collection techniques, as well as methods of data analysis and presentation.

Chapter four presents the analysis and presentation of data and discussion of results. The last chapter provides a summary of major findings, conclusion and recommendations of the study.

CHAPTER TWO

MAINSTREAMING CLIMATE CHANGE ADAPTATION IN DEVELOPMENT PLANNING

2.1 Introduction

The need to discover what is already known in the body of knowledge before initiating any research study cannot be overemphasized. This chapter therefore, presents a methodological review of past literature relating to key areas of climate change adaptation and development planning. The review begins with definitions of key concepts, to discussion on the concept of climate change and climate variability, vulnerability analysis, adaptation to climate change, the nexus between climate change adaptation and sustainable development, mainstreaming climate change adaptation into development planning, through to theoretical and conceptual frameworks.

2.2 Operationalization of Key Concepts

2.2.1 Climate Proofing

Climate change proofing is the process of guaranteeing the viability of investments in a property or infrastructure by taking climate change into account. Its purpose is to reduce climate risks to “acceptable levels through long-lasting and environmentally sound, economically viable, and socially acceptable changes” (UNDP, 2012: 6).

2.2.2 Resilience

Resilience to climate change is the capacity of a system (community) to absorb external tensions and perturbations as a result of social, political or environmental changes. Three conditions enable a social or ecological system to absorb change: ability to self-organize, ability to buffer disturbance, and capacity for learning and adapting (Trosper, 2002 as in UNDP, 2012; Hoff, 2012).

2.2.3 System

A “system” in climate change adaptation and in this study refers to a country, a community, a family, or an individual (UNDP, 2012).

2.3 Perspectives on the Concept of Climate Change and Climate Variability

According to the Third Assessment Report (TAR) of the IPCC, climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity (IPCC, 2001 as cited in Levina and Tirpak, 2006:12). The TAR emphasized that the variation or change in climate, must be statistically significant and should persist for an extended period – typically decades or longer. The IPCC’s definition also indicates two main causes of climate change; natural processes or external forcing, and persistent anthropogenic changes in the composition of the atmosphere or in land-use.

UNFCCC in a similar manner defined climate change as “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (Levina and Tirpak, 2006:12). This definition like the IPCC’s, makes a distinction between ‘climate change’ that is change in climate attributable to human activities altering the atmospheric composition of the globe and ‘climate variability’, change in climate attributable to natural causes.

Climate variability refers to the situation where the climatic parameter of a region varies from its long-term average. The IPCC TAR defines climate variability as the variations in the mean state and other statistics including the standard deviations, the occurrence of extremes, of the climate on all temporal and spatial scales beyond that of individual weather events.

From the perspective of reducing vulnerability and facilitating adaptation, it may be unnecessary to divorce climate change from climate variability. This is because climate change impacts are not significantly different from impacts from climate variability. Therefore, adopting IPCC’s and UNFCCC’s concept of climate change, the term is used in this work to refer to the observed and projected increase in average global temperature, and the associated impacts, including; an increase in extreme weather events; melting of icebergs, glaciers and permafrost; sea level rise; and changes in the timing and amount of rainfall.

2.4 Vulnerability to Climate Change

2.4.1 The Concept of Vulnerability

Vulnerability is a nebulous concept (Füssel, 2010). Definitions of vulnerability vary widely among different scholars and researchers such that Füssel described the term as almost useless when applied in an interdisciplinary context without further interpretation (Füssel, 2010:2). The concept may be perceived from the natural hazards perspective, the food security perspective, as a starting point or end point among others. It may also be considered as internal or external.

However, in the context of this study, the IPCC's view of vulnerability has been adopted. According to the IPCC, vulnerability is an integrative measure of the threats to a system (IPCC, 2001). Vulnerability according to this perspective is a function of a system's exposure, sensitivity, and adaptive capacity (IPCC, 2001b; Easterling, Hurd and Smith, 2004:3; Nelson and Agbey, 2005:19; TERI, 2006).

2.4.2 Classification of vulnerability

There are varied classifications of vulnerability in climate change literature. For instance, Yaro (2010:3) and Füssel (2006:157; 2010:3) identified two distinctive sides of vulnerabilities; internal and external. Internal vulnerability is the extent to which an individual, area, or activity is susceptible to unfavourable weather changes, that is the internal factors that determines their impacts on a system. External vulnerability on the other hand, refers to the external stressors that a system is exposed to, that is, the adaptive capacity of the local population under climate change exposure. Several researchers have also made a distinction between ecological (natural system) and social (human system) vulnerabilities, although there is no consensus on their meaning (Füssel 2006; Füssel, 2010; Stanturf et al., 2011).

Another classification is the vulnerability-security continuum provided by the African Environmental Outlook (TERI, 2006). The vulnerability-security continuum identifies vulnerability in two ways; low adaptive capacity (as in least developed countries) with limited choices and marginalization and that of security (as in developed countries) with high adaptive capacity, diversity in choices, power and control (TERI, 2006). This implies that human vulnerability or security is considered as a continuous variable, whereby vulnerability is the

negative part of the continuum and security is the positive part. Essentially, human vulnerability according to this perspective is determined by exposure to environmental hazards (or contingencies, shocks and stresses) and the coping capability of people which assures them of security.

2.4.3 Components of Vulnerability

Three key factors determine the vulnerability of a system to climate change. These are adaptive capacity, sensitivity and exposure. As discussed below, these factors represent gateways through which threats are manifested or resilience is built. This implies that a system is vulnerable if it is exposed to and sensitive to the effects of climate change and at the same time has low capacity to adapt (Fellmann, 2012). Conversely, a system is less vulnerable if it is less exposed, less sensitive or has high adaptive capacity

Sensitivity

Sensitivity is the extent to which a system is affected – either adversely/beneficially, directly/indirectly – by climate variability and/or change (IPCC, 2007:64). It is also the degree to which a system is affected by climatic stresses (Kelly and Adger, 2000:327). Sensitivity determines the degree to which a system will respond to a change in climatic conditions (Easterling, Hurd and Smith, 2004). Therefore, sensitivity to climate change depends on the characteristic of the system. For instance, a community dependent on rain-fed agriculture is much more sensitive to changes in climatic conditions than one where the main means of livelihood is mining. Also, in crop farming, maize is known to be more physiologically sensitive to climate change because, it is less resistant to changes in precipitation than a crop like cassava. Füssel (2010), have made a distinction between sensitivity and resilience in which he equated the former to what he calls internal socioeconomic vulnerability and the latter to internal biophysical vulnerability.

Sensitivity to climate change in Ghana and indeed the whole of Sub-Saharan Africa is considered high because of high reliance on the environment for livelihoods. Agriculture remains the main source of employment for over half of the population of Ghana. The nature of production in the agriculture sector is still rudimentary; rainfall dependent and the use of old methods and techniques.

Exposure

The exposure of a system to climate change is the extent to which elements of a climate-sensitive system are in contact with climate change phenomenon. It defines who and what is at risk of climate change (Muriuki, 2011). For instance, those living in arid/semi-arid regions of Ghana and low-lying coastal areas or river basins are likely to increase their exposure to drought, floods, storms and coastal erosion. Exposure as a component of vulnerability encompasses the extent to which a system is subjected to significant climatic variations as well as the degree and duration of these variations (Fellmann, 2012). To assess exposure, one must consider how humans and materials may be affected by change, as well as the change in climate itself - sea level rise, precipitation and temperature change (IPCC, 2001b; UNDP, 2012).

In one way or another, all systems are exposed to natural climate variability independent of future climate changes. However, climate change can change and increase the future exposure of the system (Label et al., 2012 as cited in Fellmann, 2012). As noted by the IPCC, defining the exposure of a unit, that is, the activity, group, region or resource that is subjected to climate change is an essential part of determining the exposure of a system to climate change stressors (IPCC, 2001 as cited in Fellmann, 2012:39). In climate change vulnerability analysis, exposure and sensitivity together describe the potential impact that climate change can have on a system. Nevertheless, a system may be characterized by high exposure and/or sensitivity to climate change and yet may not necessarily be considered vulnerable. This is because exposure and sensitivity have nothing to do with the capacity of a system to adapt to climate change (i.e. its adaptive capacity).

Adaptive Capacity

Adaptive capacity as a component of vulnerability is the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (IPCC, 2001a). Adaptive capacity is the most important component of vulnerability. The adaptive capacity of a system affects its vulnerability to climate change by moderating exposure and sensitivity (Yohe and Tol, 2002 as cited in Adger et al, 2007 and Fellmann, 2012; Gallopin, 2006).

The adaptive capacity of individuals, households and communities is preponderantly determined by their access to and control over natural, human, social, physical, and financial resources (Dazé, Ambrose and Ehrhart, 2009; CARE, 2010). These resources are described in Table 2.1

Table 2.1 Resources affecting adaptive capacity

Resource	Description
Human	Knowledge of climate risks, technology, conservation agriculture skills, good health to enable labour
Social	Women's savings and loans groups, farmer-based organizations, stable and effective institutions
Physical	Irrigation infrastructure, seed and grain storage facilities
Natural	Reliable water source, productive land
Financial	Micro-insurance, diversified income sources
Political Capital	Policies, institutions and power structures

Source: Adapted from Dazé, Ambrose and Ehrhart, 2009

Adaptive capacity and adaptation are intricately related. Adaptive capacity is viewed as a limit beyond which adaptation is no longer possible. In this way it defines the limits of adaptation – coping range and the ability of the system to develop adaptation (Levina and Tirpak, 2006). In another perspective adaptive capacity is seen simply as a characteristic of a system and its ability to adjust to climate change on its own. Adaptation therefore increases this ability.

Access to and control over the resources necessary for adaptive capacity varies within countries, communities and even households. Poor countries or societies have low adaptive capacities because they lack resources to promote adaptation. Similarly, vulnerable elements of society like women and migrants equally have low adaptive capacities owing to poor access to vital resources for adaptation (Dazé, Ambrose and Ehrhart, 2009; CARE, 2010; Yaro, 2010).

Ghana's ability to adapt to climate change will greatly depend on her adaptive capacity or the capacity of regions, district assemblies, sectors and communities to cope with the impacts and risks of climate variability and climate change. Adaptive capacity in Ghana as observed by Nelson and Agbey (2005:50) depends on several socio-economic factors such as, level of poverty, improved infrastructure, respect for indigenous knowledge and accumulated local experience, adequate financial resources, insurance mechanisms, access to public health facilities, level of education and training, adequate information and skills, access to technology,

strong institutions and effective organizations, existing early warning and protection from natural hazards.

Statistics indicate that the adaptive capacity of the MMDAs and the MDAs in Ghana are weak (Nelson and Agbey, 2005; Yaro, 2010). Therefore, improving adaptive capacity and reducing vulnerability will require coherence and synergies across all sectors, backed by a consultative and participatory process that will ensure the integration of these factors into the mainstream planning processes at national, regional and district levels. The measures required for the improvement of adaptive capacity are fundamentally equivalent to those promoting sustainable development (Nelson and Agbey, 2005; TERI, 2006). As indicated by MEST (2010), climate change poses a threat to Ghana's overall development and the sustainability of successes in poverty reduction efforts. Yet there is still limited research and knowledge on the dynamics of adaptation, the processes of adaptation decision-making, conditions that stimulate or constrain adaptation, and the role of non-climatic factors. The study will examine how development planning processes affect adaptive capacity in the Kassena-Nankana West District.

2.4.4 Vulnerable People and Places

Albeit people in all regions in the world are vulnerable in one way or another to climate change, their coping capacities are different (Africa Environment Outlook, 2014). It is therefore not surprising that globally vulnerability to climate change is disproportionately high among developing countries (Nelson and Agbey, 2005; Dazé, Ambrose and Ehrhart, 2009; Yaro, 2010). Ghana and indeed the whole of Sub-Saharan Africa is considered a climate risk zone because of vulnerable social and natural systems, multiple interacting stresses, and low adaptive capacity due to wide spread poverty (Nelson and Agbey, 2005; IPCC, 2007; Yaro, 2010; Stanturf et al., 2011; Dyoulgerov et al., 2011; Africa Environment Outlook, 2014).

Studies by Yaro (2010), Stanturf et al. (2011) and Dyoulgerov et al. (2011) and others have assessed the extent of Ghana's vulnerability to climate change. These studies indicate that social and ecological vulnerabilities are highest in the northern Savannah regions due to high exposure to climatic stresses and extremes, high sensitivity to changes in climate change and poor adaptive capacity as a result of high levels of poverty. The northern savannah zone has experienced floods as well as dry spells (droughts) over the last three (3) decades. In 2007, floods followed a period

of drought and affected over 325,000 people (Stanturf et al, 2011:7). Stanturf et al. (2011) has further argued that climate change in conjunction with other destructive land use practices such as decreased fallow period farming, deforestation, frequent bush fires, and overgrazing could accelerate the rate of desertification in northern Ghana. In effect, the resilience and productivity of much of the northern savannah zone will be progressively weakened and at worst those same areas will succumb to desertification (Stanturf et al., 2011).

Similarly, using a vulnerability index based on 11 socioeconomic indicators, Stanturf et al. (2011) equally found the three regions of the north to have the highest overall social vulnerability to climate change. Also, differential vulnerabilities exist between urban and rural districts with the latter being the worst. Women, migrants, and the unconnected (socially) landless farmers are found to be among the most vulnerable groups in the Ghanaian society (Yaro, 2010; Codjoe, Atidoh and Burkett, 2011). Under normal circumstances, these groups have difficulty accessing land and securing livelihoods. Derbile (2010) assessed environmental change in the Kassena-Nankana area and observed significant environmental changes with ramifications on the lives and livelihood of the people. Derbile's intergenerational analysis of changes in productivity levels revealed significant intergenerational decline of productivity in the agriculture sector particularly crop farming.

From the above review, it is apparently clear that vulnerability to climate change in Ghana is significantly high while adaptive capacity is low. Indeed the whole of Sub-Saharan Africa falls within the high risk and low adaptive capacity category (Fellmann, 2012). Even though, the literature indicates that vulnerability to climate change in Ghana is highest in the Northern savannah ecological zone (where the study was conducted), local level data on vulnerability to climate change seems to be lacking.

2.4.5 Vulnerability Assessment and Management

Vulnerability assessment and management involves the process of determining a system's vulnerability to climate change as well as the strategies for dealing with the vulnerability. Cima (2001) made a distinction between vulnerability assessment and vulnerability management in the context of information technology. She described vulnerability assessment as a search for the weaknesses or exposures of a system to shocks in order to apply a solution to prevent a

compromise. She also conceived vulnerability management as a broad or detailed assessment and management of risks. Vulnerability management involves the prioritization of potential risk of vulnerabilities.

In climate change adaptation, vulnerability assessment involves the assessment of climate change impacts relating to exposure, sensitivity and adaptive capacity. On the contrary, vulnerability management involves the development and application of appropriate adaptation pathways for dealing with specific climate change impacts. The conceptual delineation between vulnerability assessment and vulnerability management is not only problematic but to some extent unnecessary in the context of climate change adaptation. Therefore, this study prefer to use vulnerability assessment to encompass the processes of identifying specific climate change impacts and vulnerabilities as well as generation of appropriate strategies for dealing with them.

2.4.6 Vulnerability Assessment Frameworks/Approaches

According to Simone (2011) vulnerability is often poorly assessed due to lack of observational data relating to the physical and mechanical parameters of hazards as well as the difficulty to collect data on the inherent characteristic of the elements at risk. This notwithstanding, a gamut of vulnerability assessment techniques exist in climate change literature. For instance, the United States-Environmental Protection Agency (US-EPA, 2010) uses top-down modelling assessments involving historic analysis/paleo-climate records, literature reviews, or climate projections and bottom-up threshold approaches. Vulnerability is also assessed under the spheres of internal and external vulnerabilities within the socio-economic and biophysical domains (Fussel, 2007). Similarly, Simone (2011) has proposed four approaches for measuring/describing vulnerability to climate change. These are, heuristic, economic, empirical and probabilistic.

Most of these methods, approaches and frameworks for vulnerability assessment involve the use of rigorous quantitative techniques which fall outside the limits of this study. As a result the study adopted the IPCC's framework for measuring vulnerability. According to the IPCC's approach, three (3) key components, that is, sensitivity, exposure and adaptive capacity determine the vulnerability of a system to climate change. This approach to the analysis of vulnerability is amenable to the risk-hazard (RH) and Pressure-and-Release (PAR) models of vulnerability analysis (Turner et al, 2003).

The framework allows for the use of both quantitative and qualitative techniques depending on the type of research, the academic discipline, the purpose of the research as well as the spatial and temporal scale of the analysis. Dazé, Ambrose and Ehrhart (2009) in applying the IPCC's framework identified the components pertaining to exposure, sensitivity and adaptive capacity as well as indicators for measuring them qualitatively. Stanturf et al (2011) used a similar approach in their analysis of ecological and social vulnerability in Ghana. This work deployed these components and the indicators in assessing vulnerability in the Kassena-Nankana West District.

2.5 Adaptation to Climate Change

2.5.1 Typology of Climate Change Adaptation

Several types of adaptations exist in climate change adaptation literature. Understanding these types of adaptation measures is essential for understanding the adaptation options and approaches that are appropriate for different conditions and settings. Adaptation measures or options vary depending on factors such as timing of the measures, sectors involved, the goal and the motive for implementation. Therefore, adaptation may be reactive or anticipatory actions, or can be planned or autonomous (Easterling, Hurd and Smith, 2004; UNFCCC, 2006; TERI, 2006; IPCC, 2007). The various classifications of adaptation are discussed below.

Reactive versus Anticipatory

Reactive adaptation takes place after the initial impacts of climate change have occurred. Reactive adaptation occurs in both natural and human systems. In natural systems reactive adaptation represents coping mechanisms of organisms to environmental challenges and extremes. In human systems reactive adaptation constitutes the response of an individual or groups or institutions to changes resulting from climate change. The mechanisms for dealing with severe impacts of floods and drought may be classified as reactive.

Anticipatory or proactive adaptation on the other hand, takes place before impacts become apparent. This occurs only in human systems; natural systems have no anticipatory adaptation (TERI, 2006:8). Anticipatory adaptation refers to proactive measures put in place to manage real or potential climate change impacts. Anticipatory adaptation recognized the role of institutions

(formal and informal, national and sub-national) in facilitating adaptation (Easterling, Hurd and Smith, 2004:24).

Anticipatory adaptation may be facilitated through mechanisms such as knowledge and learning, risk and disaster management and response, infrastructure planning and development, institutional design and reform and increased flexibility of sensitive managed and unmanaged systems (Easterling, Hurd and Smith, 2004). In addition, anticipatory adaptation should focus on avoiding maladaptation and increasing technological innovation. This study will focus on anticipatory adaptation because it encapsulates all the human measures (development plans and programmes) put in place to manage and forestall the impacts of climate change.

Private versus Public Adaptation

The distinction between private and public adaptation measures is based on whether the adaptation is motivated by private or public interest (TERI, 2006:8). Therefore, private adaptation measures are taken by individual households and companies as a response to climate change stimuli. On the other hand, public adaptation is engendered by the government and its institutions at the national and sub-national levels. This study will consider public adaptation in the context development planning at the local government level.

Planned versus Autonomous Adaptation

Planned adaptation is the outcome of deliberate policy decision, based on the awareness that conditions have changed or are expected to change and that some form of action is required to maintain a desired state or condition. It is synonymous to anticipatory adaptation and takes the form of the top-down approach, through regulations, standards, and investment schemes. Such an anticipatory approach is particularly important for decisions that have long-term implications, such as the design and citing of long-lived infrastructure such as the construction of a multi-purpose dam on the White Volta to control floods and facilitate irrigation farming in the Upper East Region. It may also include other specific policy frameworks such as the Savannah Accelerated Authority (SADA). Planned adaptation forms the central locus of this study.

Autonomous adaptation on the other hand, involves changes that a system will undergo in response to changing climate irrespective of any policy, plan or decision (Easterling, Hurd and

Smith, 2004). Autonomous adaptation measures are actions taken by individual institutions, enterprises, communities and persons independently in order to adjust to their perceptions about climate risk. These autonomous actions may be short-term adjustments, and are often considered as a reactive or bottom-up approach.

Sectoral, Multi-Sectoral and Cross-Sectoral Adaptations

Sectoral adaptation measures are actions for individual sectors that could be affected by climate change (UNFCCC, 2006). For example, in agriculture, reduced rainfall and higher evaporation rates would call for new means of irrigation practices. Such a change would require a national policy framework which integrates traditional coping mechanisms along with new practices, and emphasizes on the importance of including climate change as a long-term consideration in the formulation of policies. The study will examine how the decentralized sectoral departments in the Kassena-Nankana West District are adapting to climate change impacts.

Multi-sectoral adaptation aims at actions that are drawn from various sectors (UNFCCC, 2006). It is like looking at a particular problem through different lenses. It cuts across various sectors, for example, integrated management of water, river basins or coastal zones. Linking adaptation to climate change, with management options identified in various conventions, could serve as a multi-sectoral approach.

Cross-sectoral adaptation is an integrated measure which looks at the objective in a very holistic manner (UNFCCC, 2006). For example, science, research and development, and technological innovations such as the development of drought-resistant crop varieties or new technologies.

2.5.2 Climate Change Adaptation Initiatives at the Global and Regional Levels

Climate change adaptation initiatives are plans and strategies designed to deal with current and future climate change impacts. They are adaptation schemes (programmes and projects) developed and implemented at the global, regional and national levels for adaptation to climate change.

Climate change adaptation initiatives at the global and regional levels are based on the notion that adaptation to climate change should be understood as a process and context specific; and not ‘standalone’ projects (African Ministerial Conference on Environment, 2010). Climate change

adaptation initiatives should form part of the existing development plans and strategies (e.g. poverty reduction strategies) at national and sub-regional levels across different scales. From the view Agrawal (2008), adaptation initiatives should begin with understanding current vulnerability, building capacity to support adaptation planning and implementation, learning from pilot actions and deploying strategies and measures to operationalize climate change adaptation in vulnerable regions, sectors and populations. The assessment of current, urgent vulnerabilities has resulted in country-driven priorities that are sufficient to invest in building capacity and pilot actions for climate change adaptation (African Ministerial Conference on Environment, 2010).

It has been observed that, adaptation efforts, are occurring globally, in Africa and at national levels in most of the economic sectors such as agriculture and food security, water resources, health, urban management, coastal zones, forestry, cities, tourism etc. Most of these efforts focus more on planning especially building adaptive capacity rather than implementing concrete adaptation actions. Delay of adaptation action has been blamed on limited knowledge (African Ministerial Conference on Environment, 2010). In furtherance of this argument, this study will assess the actions (or lack of action) taken by the Kassena-Nankana West District to adapt to climate change impacts and the challenges thereof.

It has also been argued that, because adaptation is a process, it is important to put into use the existing knowledge, which can be built upon as more knowledge is generated. This makes it imperative to move from reactive to proactive policies, strategies and plans. Unfortunately, existing efforts have focused much on capacity building and planning for adaptations. For instance the African Ministerial Conference on Environment have identified over sixty (60) adaptation efforts within Africa, all focusing or having a capacity building component. The emphasis on capacity building was based on the facts surrounding the uncertainty of future impacts of climate change and need to build capacity for long term adaptation. Moreover, in many circles, climate change is still considered a 'grey' area needing actions to strengthen adaptive capacity. In this context, actions are required to learn what works under which conditions and/or circumstances. Some of these actions include the implementation of National Adaptation Programmes of Action (NAPA) projects which are essential, as are an increased

coverage of types of projects and sectors. Some of these actions pertaining to Ghana are reviewed in the next sub-section.

It has also been observed that, majority of climate change adaptation initiatives were found in the public sector and particularly occurring at national levels. It is hoped that these projects or programmes contribute to the creation of adaptive capacity, which would support private and government at a later stage to be able to respond to the impacts of climate change. The adaptive capacity appears to emerge from the process of learning by doing on the potential impacts of climate change and their possible adaptation options, as a precondition for the application of adaptation actions. Most of the known adaptation actions have been driven by a host of factors such as response to regulations, individual motivations, sustainable development and financial pressures (UNDP, 2009; African Ministerial Conference on Environment, 2010). The African Ministerial Conference on Environment (2010) has indicated that waiting on climate change to drive change in African institutions in the private and public sector may not be worthwhile either in terms of precaution, or the reality of what drives change in the sub-region. It must be recalled that adaptation is a process and context specific; therefore, the 'one size fits all' does not apply, and greater understanding of the reality of change in the various sectors at different scales is vital in any change management process.

In conclusion, climate change initiatives at the global and regional levels are basically on capacity building programmes and projects targeting national institutions. However, the capacity building aspects were not embedded into existing institutional frameworks to allow for sustainability. Instead they were limited to the project life span. There were also challenges associated with different collaboration and partnerships that were initiated through these projects to complement and maximize comparative advantages. Hence the question of sustainability remains a milestone due to limited financial resources. Even though, adaptation efforts exist across different scales, many efforts seemed to be biased to national level, underestimating the sub-national levels. This study will assess these outcomes at the local government level to identify their challenges and prospects.

2.5.3 Climate Change Adaptation Initiatives in Ghana

Cameron has argued that in terms of signature and documentation to meet the external requirements of the international architecture, Ghana's response to climate change has been very good, if not outstanding (Cameron, 2011:8). Cameron's view is that in terms of concrete action, Ghana has not lived up to expectation. Her view however, is contrary to the view of Würtenberger, Bunzeck and van Tilburg (2011) who made a thorough assessment of climate change initiatives implemented in Ghana and concluded that Ghana's initiatives for climate change adaptation though not outstanding is better than all countries in the sub-region.

The first initiatives related to adaptation and climate change vulnerability assessment in Ghana were started about 15 years ago, under the Netherlands Climate Change Study Assistance Programme (NCCSAP) (Würtenberger, Bunzeck and van Tilburg, 2011). This programme was followed by the Netherlands Climate Assistance Programme (NCAP). Both programmes, gained visibility and laid foundations for the sector budget support under the Natural Resources and Environmental Governance Programme (NREG). The aim of these initiatives was to enhance Ghana's capacity to formulate and implement climate change national policies to fulfil its commitments to UNFCCC. The NCCSAP was prepared with support from EPA. The programme aided the preparation of national reports, comparison of national situations in different contexts, and contributed to an overall learning process by all concerned parties. The focus of the first phase according to Würtenberger, Bunzeck and van Tilburg (2011:15), was on sectoral vulnerability and adaptation assessments. These studies explored vulnerability in relation to a set of climate change scenarios such as changes in temperature, precipitation, etc., and proposed adaptation strategies to build resilience against threats related to climate change.

The NCAP was implemented between 2004 and 2007 by ETC International with local support from EPA and NDPC. The priority areas of the NCAP was on studies in the area of adaptation, with a specific focus on examining the linkages between poverty and climate change and the consequences of climate change on the livelihood systems of poor communities (Würtenberger, Bunzeck and van Tilburg, 2011). The ultimate objective was to formulate climate change policies consistent with the Ghana poverty reduction strategy, thus facilitating the mainstreaming

of these policies into district as well as national development plans. The research brought insights into the vulnerability of several key economic sectors such as cocoa and fisheries.

Another initiative was the Climate Change Adaptation and Development Programme Initiative (CC-DARE) which was a joint Programme by UNEP, UNDP, the UNEP Risø Centre for Energy, Climate and Sustainable Development (URC) and the UNEP Centre for Water and Environment (Würtenberger, Bunzeck and van Tilburg, 2011). The Programme began in mid-2009 and finished in November 2010. Under the Programme, development partners were asked to complement the activities under the ongoing Natural Resources and Environmental Governance (NREG) sector support Programme.

The most recent major study on adaptation in Ghana was the World Bank led study on the '*Economics of Adaptation to Climate Change*' (EACC) (Yaro, 2010; The World Bank Group, 2011). The aim of EACC study was to address the knowledge gap of climate change adaptation among developing countries by analysing the predicted climate impacts and robustly estimating the costs of adaption in nine country case studies, of which Ghana was one. In addition, the EACC study aimed to help countries to develop national plans that incorporate adaptation measures. The study was funded by the governments of the Netherlands, Switzerland and the UK.

Other initiatives identified by Würtenberger, Bunzeck and van Tilburg (2011) included the UNDP's Africa Adaptation Programme with their '*Supporting Integrated and Comprehensive Approaches to Climate Change Adaptation in Africa*' project in Ghana and 19 other African countries. The aim of the project was to assist the country to introduce dynamic and long-term planning mechanisms to manage uncertainties related to the expected impacts of climate change. Countries were also encouraged to build leadership capacities and develop institutional frameworks to manage risk at local and national levels. Another initiative is the one by CARE, an international NGO working on fighting global poverty. CARE's Programme was christened '*Adaptation Learning Programme (ALP)*' for Africa with the objective of increasing the capacity of vulnerable households in sub-Saharan Africa to adapt to climate change. Working in two districts in Ghana, ALP hoped to develop innovative approaches to community-based adaptation

(CBA), compile best practices, and empower local communities to have a voice in decision making on adaptation.

One other initiative for adaptation in Ghana was the Africa Adaptation Programme (AAP). The AAP is undertaken in Ghana by the EPA with funding from the Government of Japan. The Programme has five key areas namely, mainstreaming climate change, capacity building and leadership development, disaster early warning system, climate change economics and finance, and knowledge management (Würtenberger, Bunzeck and van Tilburg, 2011).

Apart from the above initiatives, there were also programmes targeting specific sectors including disaster risk management, water management, agriculture, social development and health.

In the area of disaster risk management, UNDP in 2008 started a short project together with the National Disaster Management Organization of Ghana (NADMO) on *'Enhancing National Strategies for Effective Disaster Risk Reduction in Ghana'*. The project lasted 12 months and financial support of 140'000 USD was provided via UNDP. Also related to this were the *Ghana North Sustainable Development, Disaster Prevention and Water Resources Management (GFDRR)* which was funded by the World Bank and implemented between 2008-2013. The *GFDRR* programme aimed to prepare a Comprehensive Disaster Risk Management and Climate Adaptation Program for Ghana in close collaboration with the government and development partners. According to Würtenberger, Bunzeck and van Tilburg (2011), the programme has since not started. Another initiative in this area is the *'Programme for the Improvement of Capabilities to Cope with Natural Disasters Caused by Climate Change'* funded by Japan to the tune of 8.5 million US dollars. Also, the Vodafone Ghana funded *'Raising awareness for climate change'* project was an example of the otherwise limited private sector involvement in adaptation in Ghana. The project was implemented through the EPA, together with the Ghana Meteorological Agency, NADMO and the Ministries of Health, and Food and Agriculture

Other initiatives by government to enhance adaptation include the National Climate Change Policy Framework (NCCPF) which was approved by Cabinet in May 2013, Green Growth initiative, Reducing Emissions from Deforestation and Forest Degradation (REDD) and the Savannah Accelerated Development Authority (SADA) among others (MEST, 2010).

In conclusion, over the last two decades Ghana has hosted numerous climate change related activities, initiated by international donors or research organizations, representatives of the Ghanaian government, academia and civil society. However, many of these initiatives have been relatively small-scale, and coordination across sectors, ministries or regions has often been lacking. In addition, some of the initiatives were pilot programmes with spatial and temporal limitations. Most of the initiatives were also bias towards capacity building to the neglect of actual tangible adaptation measures. Also, of concern is the fact that majority of the climate change initiatives had external funding, hence, making their sustainability uncertain. The literature has shown that most of the initiatives were national in character without specific programmes for local adaptation. Finally, the literature has revealed that there is little private involvement in climate change adaptation programmes in Ghana. In the light of all these, the study will assess initiatives for adapting to climate change at the local level and the extent to which they are mainstreamed into development planning in the Kassena-Nankana West District.

2.6 The Nexus between Climate Change Adaptation and Sustainable Development

Sustainable development as a concept is notoriously difficult, slippery and elusive to pin down (Williams and Millington, 2004). Fowke and Prasad identified at least eighty (80) different, often competing and sometimes contradictory, definitions (Fowke and Prasad, 1996 as cited in Dimitrov, 2010). To avoid this intellectual contest, the study adopts the most widely quoted Bruntland Report's definition of sustainable development that sees sustainable development as development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. This definition considers the world as a system that connects space and time. Sustainable development also refers to the process of sustaining development interventions in order that they continue to deliver desired benefits for an expected period of time.

The nexus between climate change adaptation and sustainable development are several and varied (Banuri and Gupta, 2000; Robinson and Herbert, 2001). Sustainable development and climate change are known to interact in a circular fashion. The goal of every nation is to achieve and sustain development. Climate change poses a great threat to the achievement of national

poverty reduction and sustainable development particularly the Millennium Development Goals (AfDB et al., 2002; Nelson and Agbey, 2005; MEST, 2010).

The worse impacts and burdens of climate change would be visited on agricultural and water systems, forests, fisheries, human health and infrastructure. These impacts could worsen existing conditions of poverty, malnutrition and illness, and put pressure on natural resources and ultimately exacerbate the vicious cycles of those conditions. TERI (2006) has noted that, climate change relates to sustainable development through the impediments that it poses to and the implications on the opportunities for socio-economic development and issues of equity and justice.

Conversely, the impacts of climate change can be minimized through proactive and conscious efforts such as mainstreaming adaptation and mitigation into development processes and strategies (Füssel and Klein, 2004). The wider development goals can be achieved by building institutions to address current socio-economic and environmental problems, and to augment social capital; stimulating technological innovation, promotion of environmentally friendly technologies; development of drought-resistant varieties of crops can help in ameliorating the capacity to cope and adapt to climate variability and change (Kok and de Coninck, 2007).

Because, climate change is an impediment to the achievement of development goals, recognizing how climate change is likely to impact development priorities is crucial in developing cost-effective strategies and build institutional capacity in developing countries where the impacts of climate change are more pronounced and opportunities to adapt are limited. In order to effectively support adaptation and to minimize risks associated with predicted impacts, there is an urgent need to integrate adaptation issues and considerations into development plans and budgets. As noted by Lebel et al (2012) both current and future climate-related risks need to be addressed in plans. This will promote climate proofing and sustainable development (Dazé, Ambrose and Ehrhart, 2009; CARE, 2010).

In Ghana, challenges posing a threat to sustainable development have been broadly classified by Kuuzegh (2007) as degraded natural resource base; carbon intensive energy supply and inequitable access to energy; adaptation deficit; and disasters. Government's efforts to tackle

these problems are constrained by lack of predictable finance, weak institutional coordination, low capacity to retain expertise with the government system, and the persistence of reactive management approaches.

2.7 Mainstreaming Climate Change Adaptation into Development Planning

2.7.1 The Concept of Mainstreaming

Oates, Conway and Calow (2011) have argued that the meaning of mainstreaming is a conceptual confusion. According to them mainstreaming is often poorly defined and used interchangeably with others terms such as ‘integration’ or ‘multi-sectoral response’. As a result, the concept is open to interpretation, which can lead to confusion, manipulation or inaction. Therefore, conceptual clarity is needed to provide a solid basis for its application in development policy, planning and action.

The term ‘mainstreaming’ in climate change is used interchangeably with ‘integration’. The term is used by Gigli and Agrawala (2007) to describe the process of integrating adaptation to climate change into development assistance. The term is also often associated with the process of taking into consideration potential climate change impacts when making investment or development assistance decisions (OECD, 2009). Similarly, it is the integration of priority climate change adaptation responses into development, so as to reduce potential development risks and take advantage of opportunities. The objective is for adaptation measures to be implemented “as part of a broader suite of measures within existing development processes and decision cycles” (OECD, 2009:60; UNDP, 2012).

UNDP’s view of mainstreaming (adopted for this study) seems to provide the level of clarity required by Oates and co. The UNDP defined mainstreaming as the integration of adaptation objectives, strategies, policies, measures or operations such that they become part of the national and regional development policies, processes and budgets at all levels and stages (UNDP, 2005 as cited in Levina and Tirpak, 2006). Also consistent with this view is the UNDP-UNEP concept which describes mainstreaming in climate change adaptation as the iterative process of integrating climate change adaptation into development policy-making, planning, budgeting, implementation and monitoring processes at national, sector and sub-national levels.

Mainstreaming is perceived in this way as a multi-year, multi-stakeholder effort grounded in the contribution of climate change adaptation to human well-being, pro-poor economic growth, and achievement of the MDGs. It also entails working with a range of government and non-governmental actors, and other actors in the development field (UNDP-UNEP, 2011).

2.7.2 Perspectives on Mainstreaming as a Strategy for Climate Change Adaptation

Adaptation to climate change like planning is a continuous process; it is not expected that adaptation can be dealt with at one time. Moreover, adaptation process requires regular revisiting of development policies, plans and projects as climate and socio-economic conditions change (OECD, 2009). This makes mainstreaming a development-oriented approach to climate change adaptation (Oates, Conway and Calow, 2011). As noted by Elsey, Tolhurst and Theobald (2005), the idea about mainstreaming is that, cross-cutting issues should be embedded in the activities of development, rather than being addressed in separate initiatives. Consequently, the mainstreaming approach has been lately adopted in the context of climate change.

Mainstreaming is not a new concept. The concept has been used since the 1990s as a means to more effectively tackle development issues such as gender inequality, environmental degradation, HIV/AIDS, disability and poverty reduction in the developing world (Oates, Conway and Calow, 2011; Lebel et al, 2012). Mainstreaming in adaptation to climate change hopes to extract useful lessons from these areas. One notable lesson was the Beijing Conference in 1995 (the Platform for Action at the Fourth World Conference on Women) where mainstreaming was adopted as a global strategy for the promotion of gender equality. Though ten years later, it had become an important element of many policies, its implementation has been inconsistent, and the outcomes for gender equality remained largely unknown (Moser and Moser, 2005). As observed by Kusakabe, many barriers to mainstreaming gender have been identified including a lack of meaningful participation and political commitment as well as persistent practices within organizations that continue to discriminate against women (Kusakabe, 2005 as cited in Kumari, 2013).

Mainstreaming was also used in the Poverty-Environment Initiative, which was a joint effort between the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP). The initiative has supported the mainstreaming of poverty

and environment linkages in national development planning (UNDP-UNEP, 2011). In this area too, mainstreaming have not fully succeeded in promoting recognition of the value of ecosystem services and environmental protection for human development.

Notwithstanding the above challenges, mainstreaming remains the best approach for developing policies, plans and programmes to address key issues of development. Following the recognition that climate change could significantly undermine development by threatening critical resources and increasing the incidence and severity of natural disasters, there is the clamour to not only reduce greenhouse gas emissions (mitigation) but more importantly to aid and facilitate adaptation to unavoidable climate change impacts. To this end, the mainstreaming approach has been adopted as the strategy for addressing climate change impacts. It is the onus of this study to assess the extent to which mainstreaming has been used as a strategy for dealing with climate change adaptation in Ghana particularly the Kassena-Nankana West District.

2.7.3 Mainstreaming Climate Change Adaptation into Development Planning in Developing Countries

It has been argued that mainstreaming has become increasingly popular in international donor circles over the past five to ten years and is being adopted by developing country governments for long-term strategic planning (OECD, 2009; Oates, Conway and Calow, 2011). Mainstreaming according this view is seen as ‘holistic’ or ‘development-first’ approach, through which adaptation and mitigation objectives are integrated into development agendas (Oates, Conway and Calow, 2011). In other words, climate change risks are not considered and addressed through separate initiatives but inform ongoing development policy-making, planning and activities across all sectors (Klein et al., 2007; Olhoff and Schaer, 2010).

Mainstreaming climate change adaptation in the global development arena and among developing countries is viewed at two levels; the strategic mainstreaming level and the operational mainstreaming level (Dazé, Ambrose and Ehrhart, 2009; Olhoff and Schaer, 2010; Oates, Conway and Calow, 2011; Downing, 2012). Strategic level mainstreaming, according to Dazé, Ambrose and Ehrhart (2009), addresses the organizational environment within which policies and programmes are planned and implemented. This involves activities such as building staff awareness and capacity, building institutional structures and procedures, and identifying

entry points for adaptation action. Downing's view concerning these activities is that, they constitute entry points for adaptation action in themselves (Downing, 2012).

Operational level mainstreaming on the other hand, has two objectives, namely climate proofing and building adaptive capacity (Dazé, Ambrose and Ehrhart, 2009:23). Climate proofing is a means to ensure that development interventions are resilient over the long term as well as reducing climate-related risks to acceptable levels (Dazé, Ambrose and Ehrhart, 2009; Olhoff and Schaer, 2010). Building adaptive capacity means enhancing, and not inadvertently constraining the ability of individuals, communities or institutions to respond to climate change (Dazé, Ambrose and Ehrhart, 2009).

It has also been observed that, in many developing countries, the process of mainstreaming is at the elementary stages and there is very little accepted doctrine on how the process should occur (Oates, Conway and Calow, 2011). This is explained by the fact that most of the climate change initiatives are designed and implemented through official development assistance. Brown and Bird have indicated that, the prevailing international funding mechanisms for adaptation in developing countries are geared towards providing financial resources that they termed 'additional' to existing development aid budgets (Brown and Bird, 2009). This principle of 'additionally' they noted, could conflict with the mainstreaming approach as it discriminates between adaptation and development, thereby hindering the conceptual integration of the two. As a result, poverty reduction and adaptation remain largely separate strategies in most developing countries (Nelson and Agbey, 2005; Prowse, Grist and Sourang, 2009). The risk is that 'additional' funding creates incentives for recipient countries to design 'additional' projects or programmes for adaptation, rather than addressing climate change through existing sustainable development and poverty reduction initiatives (Oates, Conway and Calow, 2011).

Despite this, Poverty Reduction Strategy Papers are perceived by some scholars as useful entry points for mainstreaming climate change adaptation in many developing countries (Kok and de Coninck, 2007; ADB, 2009; Björklund, Tropp and Harlen, 2009; UNDP-UNEP, 2011; Lebel et al., 2012). Indeed, there is a growing awareness among developing countries about the intricate linkages among adaptation to climate change, poverty reduction and rural development (Nelson and Agbey, 2005; Kok and de Coninck, 2007; Lebel et al., 2012). Even so, Kok and Coninck

(2007) and et al. (2007) have noted that environment, natural resource and disaster management issues are rarely covered in these papers. For instance, in Nepal, as much as 50-65 per cent of official development assistance (ODA) funding goes to activities that could be affected by climate change (Agrawala and van Aalst, 2008; Lebel et al., 2012). This notwithstanding, poverty reduction strategy papers for Nepal have paid little attention to climate-related risks or the potential impacts of climate change (Agrawala, 2004). However, the experience of Bangladesh is different; the links between natural hazards, poverty and potential impacts of climate change are well acknowledged in the national poverty reduction strategies (Lebel et al., 2012). Not until lately, poverty reduction strategies in Ghana have trivialized climate change (Nelson and Agbey, 2005).

The review has indicated that, mainstreaming adaptation into development planning in developing countries still remains a challenge. Despite growing awareness about the need for mainstreaming, not much has been done by individual governments. Even though, poverty reduction strategies constitute the window for mainstreaming adaptation in developing countries, some countries are yet to incorporate adaptation into poverty reduction strategies.

2.7.4 Development Planning in Ghana

Development planning in Ghana dates back to the colonial times when in the 1920s the first national development plan was prepared under the colonial administration. The colonial system of planning was highly centralized with limited or no grassroots participation in the planning process. After independence, various attempts were made to reform the colonial system which culminated into what is now known as the decentralized Local Government System and Decentralized Development Planning system (Bandie, 2007; Agyemang, 2010; MOFEP, 2010). Under the new local government system, planning takes place in a decentralized system involving national, regional, district and community levels. The new planning system is a bottom-up approach to planning which encourages grassroots participation in plan preparation, implementation, monitoring and evaluation (Bandie, 2007; Agyemang, 2010).

Decentralized planning in Ghana derives its legal basis from the 1992 constitution. The Local Government Act 1993 (Act 462) emphasizes the "administrative district" as the focal point of planning activity (Bandie, 2007; Agyemang, 2010). The law also established the Metropolitan,

Municipal and District Assemblies (MMDAs) and their sub-structures as well as their roles and functions in terms of development planning. The National Development Planning (Systems) Act, 1994 also specifies the institutions and agencies responsible for planning and their roles and functions. For instance, Section 2 sub-section 1 of the Act spells out DA's planning functions and section 7 defines the functions of District Planning and Coordinating Unit (DPCU) which include assisting the DAs to execute its planning functions. In addition, the National Development Planning Commission Act, 1994, established the National Development Planning Commission (NDPC) as the body responsible for national planning – setting national policies and strategies (Bandie, 2007; Agyemang, 2010).

The Decentralized Development Planning System in Ghana has a multi-stage structure. This is specified by the National Development Planning Systems Act 1994, Act 480 as shown in Figure 2.1 The planning process starts at the sub-district level and graduates through the district level, regional level to the national level. Section 1 sub-section 2 of the National Development Planning (Systems) Act, 1994 (Act 480) states categorically that, the decentralized national development planning system shall comprise District Planning Authorities at the district level, Regional Coordinating Councils at the regional level and Sector agencies, Ministries and the Commission at the national level (MOFEP, 2010).

National Level Planning

Planning at the national level in Ghana is the prerogative of the NDPC as specified by National Development Planning Commission Act, 1994. Basically the planning function of the NDPC include policy formulation, preparation of national development plans and budgets, coordination of sectoral ministries/agencies and the preparation of guidelines for district level planning.

Also at the national level are the sectoral plans which are prepared by the Ministries, Departments and Agencies at the national. The sectoral plans are required by law and prepared under the guidance and specifications of the NDPC.

Regional Level Planning

The Regional Coordinating Council (RCC), established under the Local Government Act, 1993 (Act 462), superintends development planning in each of the ten regions of Ghana. The RCC monitors, coordinates and evaluates the performance of the District Assemblies in the region.

They do this by providing the District Planning Authorities with information and data as is necessary to assist them in the formulation of district development plans; co-ordinate the plans and programmes of district council and harmonizes them with national development policies and priorities for consideration and approval by the Commission. The RCC also monitor and evaluate the implementation of the programmes and projects of the District Planning authorities within the region. RCC equally has powers to act on behalf of the NDPC with respect to such national programmes and projects in the region.

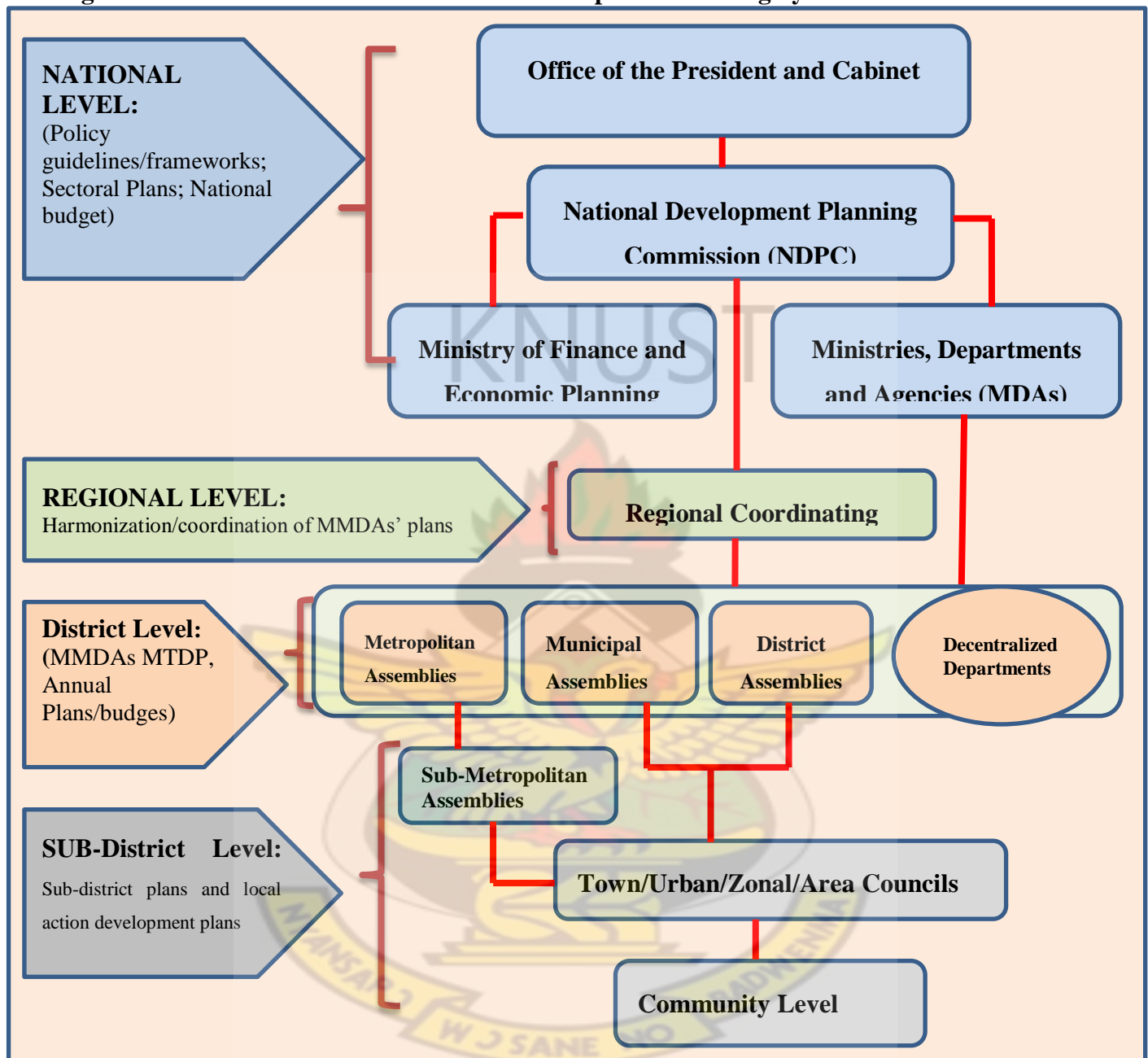
District Level Planning

The Local Government Act, 1993 (Act 462), established all MMDAs as planning authorities in Ghana. Among other functions as specified in Section 2 (1) of Act 480, MMDAs are to initiate and prepare district development plans and settlement structure plans in the manner prescribed by the NDPC and ensure that they are prepared with full participation of the local community. They are also to carry out studies on development planning matters in the district including studies on economic, social, spatial, environmental, sectoral and human settlement issues and policies. The mobilization of human and physical resources for development is also emphasized.

The Local Government Act, 1993 (Act 462) also empowered the districts to direct, supervise and conduct public hearings on the preparation of sub-district or local community plans. Also, the district through the DPCU is required to coordinate the planning activities of sectoral departments in the district responsible for the economic production, social services, technical infrastructure, environmental management and other appropriate agencies connected with the planning process. In addition, the DPCU is required to synthesize the strategies relating to the development of the district into a comprehensive and cohesive framework.

There is also a planning Committee which is a statutory body mandated for the vetting and approval of building and development plans. The Planning Committee meets monthly to consider development applications submitted by applicants to the Town & Country Planning Department. The applications are often vetted by planners and engineers from the Works Department.

Figure 2.1 Structure of the Decentralized Development Planning System in Ghana



Source: Author's Construct, 2014

2.7.5 Mainstreaming Climate Change Adaptation within the Decentralized Planning System in Ghana

Development planning is a multi-level and multi-time scale activity involving policy formulation, planning, resource allocation, implementation and review at the national, sectoral and sub-national levels (OECD, 2009; Lebel et al, 2012). The constitution of the republic of

Ghana has made sufficient provisions for effective and responsive policy formulation and planning at all levels to address development challenges including climate change.

The strengthening of appropriate institutions to tackle climate change has been seen as key to fighting the climate change menace in developing countries particularly Ghana. For instance, The World Bank Group (2011) has argued that, adaptation to climate change occurs in institutionally rich contexts and that there is a direct link between the success of adaptation and the performance of local institutional structures. In particular, public institutions (including planning institutions) have a specific role to play in channelling resources to strengthen the adaptive abilities of the poor. Similarly, national institutions remain central actors in climate policy development as they establish the overall normative and regulatory framework and ensure the delivery of environmental protection to citizens (Nuttall and Ouarzazi, 2009). Also, in accordance with the principle of subsidiarity, decentralized decision-making levels should be responsible for activities which can be performed effectively at a more immediate or local level (Nuttall and Ouarzazi, 2009).

Ghana has made significant strides in its attempts to tackle climate change (MEST, 2010). Apart from being a signatory to a number of conventions on climate change, the country has through international assistance, made efforts to reduce vulnerabilities and to increase the adaptive capacity of the country (Cameron, 2011). For instance, efforts have been made towards the building of institutional structures and capacities. These include the establishment of the National Climate Change Committee (NCCC), National Climate Change Policy Framework (NCCPF), and Savannah Accelerated Development Authorities among others. The aim of NCCPF is to ensure coherence and synergies across all sectors, backed by a consultative and participatory process to ensure the eventual integration of adaptation to climate change into the main planning processes at national, regional and district levels.

Climate change adaptation has been mainstreamed into the Ghana Shared Growth and Development Agenda (GSGDA), the national policy strategy document of the government prepared by the NDPC as a policy guideline for planning at all levels (MEST, 2010). Previous policy documents (GPRS I & II) had no climate change components (Nelson and Agbey, 2005). The GSGDA has identified four key areas for adaptation; infrastructure, natural resources, agriculture and food security and disaster preparedness and response (MEST, 2010). Following

this move at the national policy level, sectoral ministries, departments and agencies at the national level are expected to take a cue and mainstream climate change adaptation into sectoral plans and budgets. As part of the mainstreaming process, capacity building programmes for institutions are on-going at the national and sub-national levels. There is also observed collaboration between the National Development Planning Commission, the Environmental Protection Agency, National Disaster Management Organization and the MDAs for knowledge sharing on adaptation.

The sub-national levels represent the actual battle grounds for climate change adaptation and mitigation. It is at MMDAs level of planning that actual operationalization of the policies concerning climate change adaptation takes place. The decentralized sub-national structure for decision making and development planning constitutes a huge potential for mainstreaming climate change adaptation in Ghana. Capacity building for effective mainstreaming of climate change adaptation at the sub-national level is still on-going (MEST, 2010). According to the Africa Adaptation Programme (AAP) – Ghana, all MMDAs in Ghana were trained on how to mainstream climate change adaptation and disaster risk reduction into their plans and programmes.

The process involves training local government staff, staff of decentralized departments and other stakeholders at the local level and strengthening their capacity to integrate climate change issues in plans and budgets. The composite budgeting process introduced lately, also constitutes an entry point for climate change mainstreaming since climate change is a cross-cutting issue. The AAP Ghana has indicated that in 2012, 43 percent of MMDAs, had climate change adaptation activities mainstreamed in their composite budgets allocating over 27 million Ghana Cedis to implement climate change adaptation activities in their districts.

Some challenges to mainstreaming climate change within the decentralized structure have been identified. The EPA in its Policy Advice Series 1, have noted that, local responses to the impacts of Climate Change are not targeted at increasing resilience and therefore, still reactionary. In addition, due to perhaps, inadequate technical and financial capacities at all levels of the development planning processes, efforts to ensure a climate-change-proof economy have not quite materialized.

Similarly, the linkages between climate change and development is still considered weak (Nelson and Agbey, 2005). In the GSGDA, climate change is just one of the ten (10) sub-topics under the sub-area of sustainable natural resource management, under the broad thematic area of agricultural modernization and sustainable natural resource management (NDPC, 2010). This means that climate change is yet to take an exalted status in national development policy. Climate change is a cross-cutting issue and affects not only agriculture and natural resources but all sectors. Consequently, commitment to the cross-sectoral approach to climate change issues has been weak – climate change adaptation from the view point of some ministries, agencies and departments is an environmental issue. Thus, the onus lies on Ministry of Environment Science and Technology (MEST) to address climate change issues. It is critical that ministries that play a key role in development, such as Ministries of Planning, Finance, Agriculture and Trade, are also engaged in the development of adaptation strategies to ensure effective targeting and allocation of resources.

Furthermore, even though the AAP Ghana has championed the incorporation of climate change adaptation and disaster risk reduction into the Ghana Building Code, the UNDP-UNEP (2010) have noted that the capacity of local authorities to enforce land use plans, standards and guidelines and other approaches have been generally weak. This study will explore these challenges in the Kassena-Nankana West District.

2.8 Theoretical Frameworks for Planning and Mainstreaming Climate Change Adaptation

2.8.1 Introduction

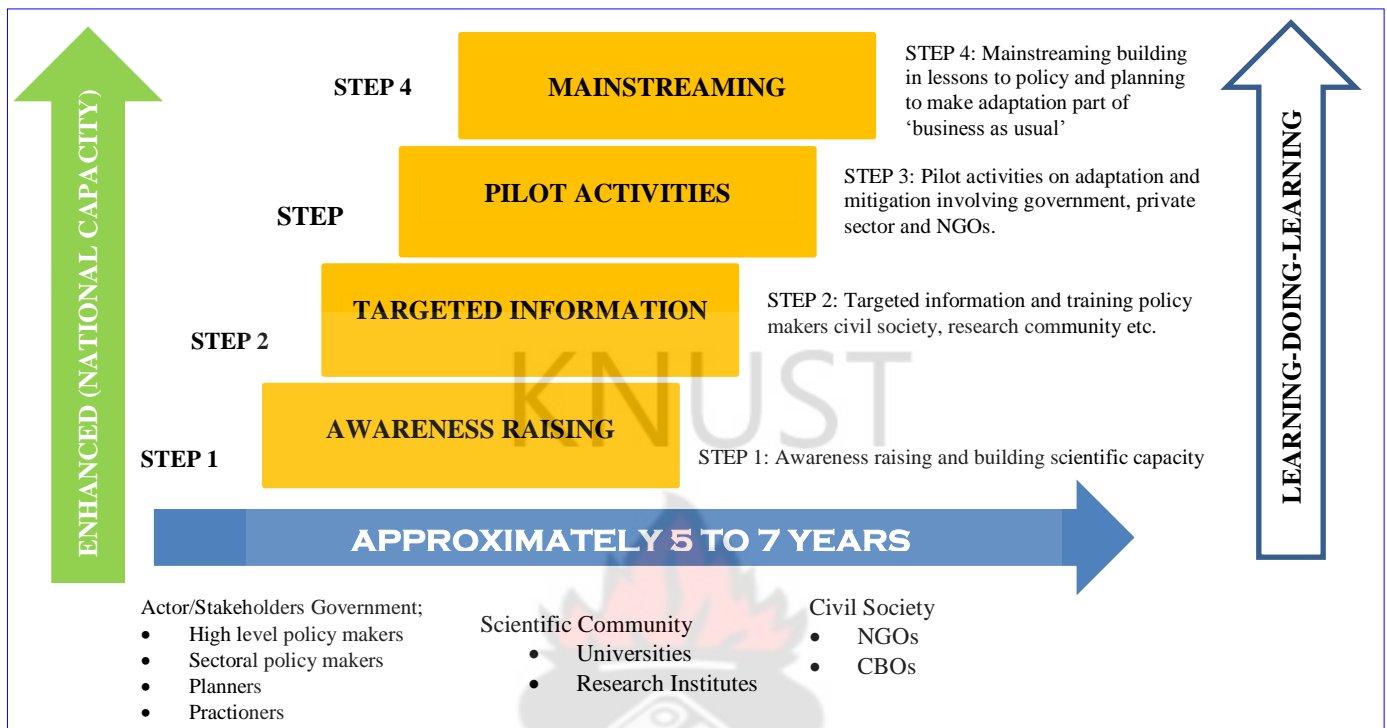
Development planning is a multi-level and multi-time scale activity that should be responsive to policy and accountable to the public (Lebel et al, 2012). National policies and plans drive resource allocation, and shape sectoral and sub-national plans. These national policies and plans take the form of development frameworks. A framework contains guidelines, principles, procedures and processes for policy formulation and planning. Several guidelines or frameworks have been proposed on how to integrate climate change concerns into ongoing national development planning processes. In this study, the Four-Step and the Poverty-Environment Initiative frameworks are reviewed.

2.8.2 The Four-Step Framework (Huq and Ayers, 2008)

One attractive feature of Huq and Ayers (2008) four-step framework for mainstreaming climate change adaptation into development planning is its simplicity. The framework is a linear sequence involving awareness and scientific capacity building, targeted information, and training of key stakeholders, which follow pilot studies to inform policy-makers and persuade them to incorporate the lessons learned into policy and planning. This is depicted in Figure 2.2

Huq and Ayers have indicated that the entire period of mainstreaming may take 5 to 7 years. The first step is about awareness raising and building scientific capacity. This involves the sensitization about climate change impacts and research into current and future impacts, vulnerability assessment, profiling and mapping among others. The next step is about targeting information to key stakeholders and training policy makers to enhance their capacity for mainstreaming. Step 3 is for implementation of pilot activities on adaptation and mitigation. At this stage, a collaborative effort involving the government, private sector and NGOs is required. The last stage in the mainstreaming process according to Huq and Ayers (2008) is where lessons from the implementation process are fed-back into policy and planning to make adaptation part of 'business as usual' condition. The framework also involves the process of 'learning-doing-learning' through the feedback process and acknowledges three (3) groups of key actors. The process is geared towards enhancing national capacity for adaptation.

Figure 2.2 Huq and Ayers Four-Step Framework for mainstreaming Adaptation



Source: Huq and Ayers, 2008

Huq and Ayers Four-Step framework is not foolproof. The framework has been criticized for ignoring critical issues such as governance, planning and implementation (Lebel et al., 2012). It also assumes lack of knowledge as the main constraint, and participation is driven by instrumental concerns. Also, no arrangement is made for planned evaluation or policy review. Under the framework, pilot activities are intended to provide governments with experience, but it is not clear how mainstreaming will emerge from these activities, or how training and greater knowledge will lead to appropriate pilot projects. Similarly, the framework failed to describe clearly how climate change adaptation should be mainstreamed into existing planning systems and how that can promote sustainable development. Indeed, the model failed to establish a linkage between mainstreaming and enhanced adaptive capacity (which may lead to sustainable development). Even though, the model can be applied both national and sub-national levels, it seems to focus on national level mainstreaming.

2.8.3 Poverty-Environment Initiative framework for mainstreaming (UNDP-UNEP, 2011)

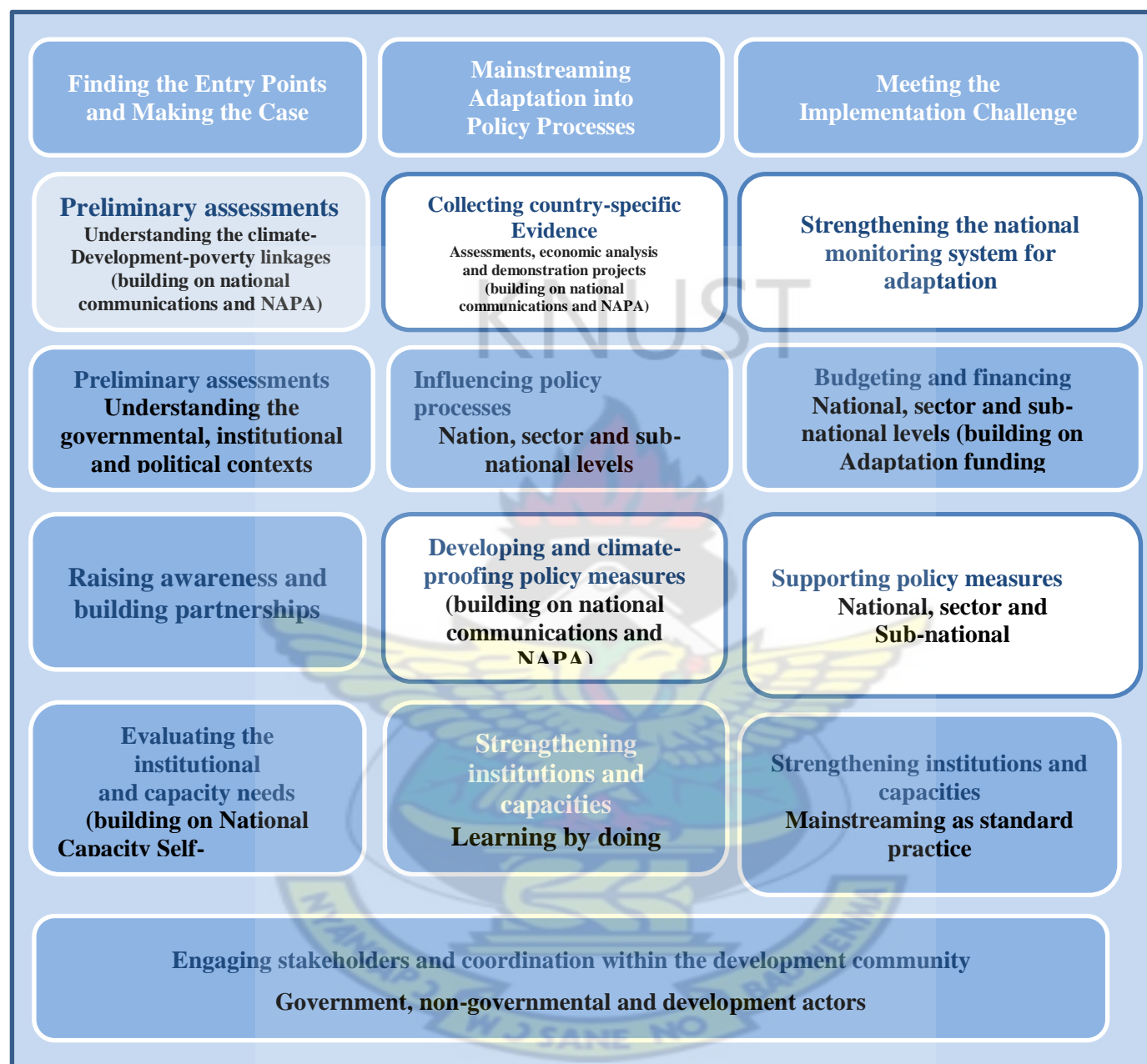
This framework is much broader than the four-step framework discussed above. Poverty-Environment Initiative framework for mainstreaming covered policy, planning and

implementation. As seen in Figure 2.3, the framework has three main components; finding the entry points and making the case; mainstreaming adaptation into policy processes, and meeting the implementation challenge (UNDP-UNEP 2011; Lebel et al, 2012). Stakeholder engagement is emphasized throughout the policy cycle, and the process is assumed to be iterative and integrative (Lebel et al, 2012). The framework builds on experiences with poverty-environment mainstreaming, and this emphasis is apparent in the framework's sub-components, checklists and assessment questions.

The first component of the framework pinpoints where to start mainstreaming and how to prepare for it. It has similarities to the Four-Step framework (Figure 2.2). At the national level, the framework pays attention to key strategy documents and budget allocation processes. It also involves evidence gathering from impacts, vulnerability and adaptation assessments, analyses of the costs and benefits of adaptation options, and lessons learned from demonstration projects, to inform decisions about modifying policies or initiating new interventions (Lebel et al, 2012).



Figure 2.3 Poverty-Environment Initiative Framework for Mainstreaming



Source: UNDP-UNEP, 2011

Notwithstanding its comprehensiveness, two main caveats limit the use of the Poverty-Environment Initiative Framework as an explanatory model of mainstreaming climate change adaptation. First, the model is overly national in character. It vividly describes how mainstreaming of climate change adaptation can take place at the national level, and therefore paid little attention to local or sub-national level mainstreaming. Also, the model like the four

step model, the Poverty-Environment framework failed to describe clearly how climate change adaptation should be mainstreamed into existing planning systems and how that can promote sustainable development.

2.9 Conceptual Framework

As noticed in the review of literature, development planning, climate change adaptation and indeed sustainable development are conterminous concepts. Despite this, existing models (Four Step Framework as well as the Poverty-Environment Framework) have failed to establish this linkage. Basically, the short-comings of the Four Step Framework and the Poverty-Environment Framework has called for alternative explanation to mainstreaming climate change adaptation in development planning. Thus, the conceptual framework discussed in this section is an attempt to capture the understanding of the author about the concepts. The conceptual model or framework in Figure 2.3 seeks to explain the relationship among fourteen variables or concepts in relation to the phenomenon under investigation. The model is explained in two ways; the normal processes of adaptation and the adaptation induced by planning.

In the normal process (indicated by the blue arrows), climate change impacts are influence by two factors, that is, adaptation and mitigation (IPCC, 2007). The adaptation component is the focus of this study. Adaptation in the diagram may be reactive or proactive (Easterling, Hurd and Smith, 2004; UNFCCC, 2006; TERI, 2006 and IPCC, 2007). Adaptation is determined by vulnerability which is also a function of adaptive capacity, sensitivity and exposure. All three (3) depend on the characteristics of the system.

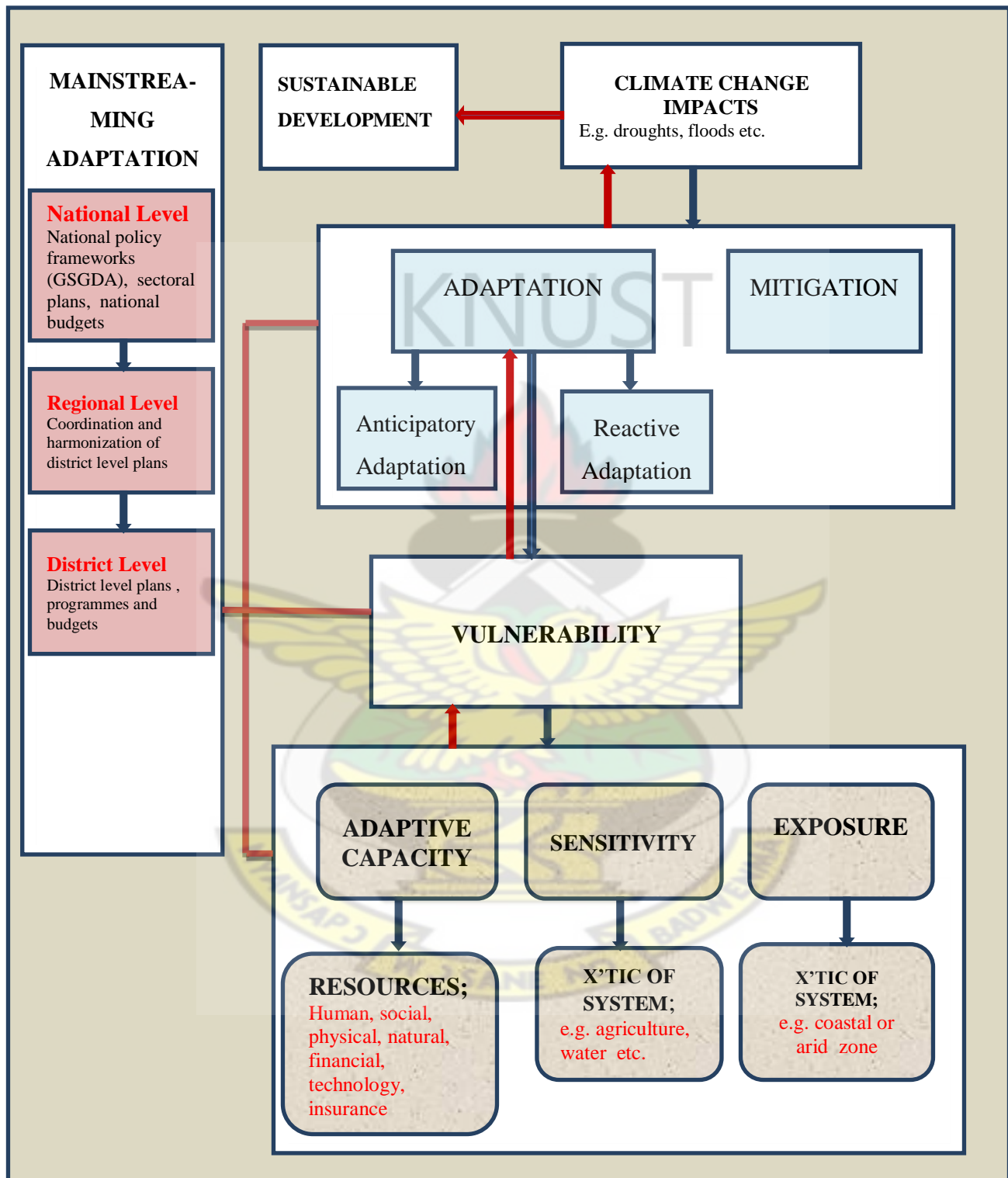
Planning, that is, development planning as shown in the model is a multi-stage activity comprising national level planning which involves the formulation of policies, preparation of national policy frameworks/guidelines (e.g. GSGDA) by the NDPC, national level budgeting by the MoFEP, preparation of sectoral plans and budgets. At the regional level, plans prepared by the districts are harmonized to ensure compatibility with national policies and guidelines. The implementation of district plans is also coordinated at the regional level. At the district level, local plans are prepared in conformity with the national guidelines issued by the NDPC. District composite budgets are also prepared using the guidelines from the Administrator of the District Assembly Common Fund. The mainstreaming process involves the integration of climate

change (adaptation) issues in national policies, plans and budgets, the inclusion of climate change adaptation issues in district plans and budgets and coordination of these activities at the regional levels.

In the model, mainstreaming has ramifications on adaptive capacity, exposure, and sensitivity which influence vulnerability, adaptation and mitigation and eventually sustainable development. This is shown by the red arrows. For instance, district and national adaptation programmes and projects have the tendency to increase people's access to and control of the resources needed for adaptation. As a result, adaptive capacity will be improved which will have a domino effect on vulnerability (improved). The adaptation options will now be both anticipatory (long-term adaptation measures) and reactive (in response to disasters). Once, adaptation is improved through planning, then ultimately, climate change impacts will be managed. In the same way, mitigation issues when integrated into the development planning process will in the long-run minimized climate change impacts. When climate change impacts are minimized by mitigation and managed through coordinated efforts of adaptation, then sustainable development can be achieved.



Figure 2.4 A conceptual Framework for enhancing adaptation through mainstreaming



Source: Author's Construct, 2014.

2.10 Summary of Literature Review

From the review of relevant literature, adaptation to climate change is the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Adaptation is largely influenced by vulnerability which is a function of adaptive capacity, sensitivity and exposure. Vulnerability is viewed from different perspectives. However, all the different perspectives suggest that vulnerability is simply the extent to which a system is susceptible to climate change.

The measures required for the improvement of adaptive capacity and reducing vulnerability are fundamentally equivalent to those promoting sustainable development. As indicated by MEST (2010), climate change poses a threat to Ghana's overall development and the sustainability of successes in poverty reduction efforts. Yet there is still limited research and knowledge on the dynamics of adaptation, the processes of adaptation decision-making and conditions that stimulate or constrain adaptation. Also, studies on vulnerability assessment at local levels in Ghana and in most developing countries are limited and to a large extent, non-existent. The study will fill this research gap by assessing the vulnerability situation in the Kassena-Nankana West District.

The literature also typologized adaptation basically into planned/proactive and reactive/autonomous; sectoral/multi-sectoral/cross-sectoral and private or public adaptation. Adaptation initiatives, measures, programmes and projects in Ghana have not been assessed and classified as such in literature. This study will identify and assess the nature and types of adaptation to climate change in the Kassena-Nankana West District.

In addition, Ghana's decentralized planning system represents a potential for mainstreaming climate change adaptation into development strategies and programmes. The literature has shown that climate change has been mainstreamed in national development policies particularly the GSGDA, though in a limited way. There are also on-going efforts of capacity building at the national and sub-national levels for climate change mainstreaming. However, little is known about the extent to which local authorities are incorporating climate change adaptation issues into their plans and budgets. This study will satisfy this research need and extent literature in this research area.

CHAPTER THREE

METHODOLOGY OF THE STUDY

3.1 Introduction

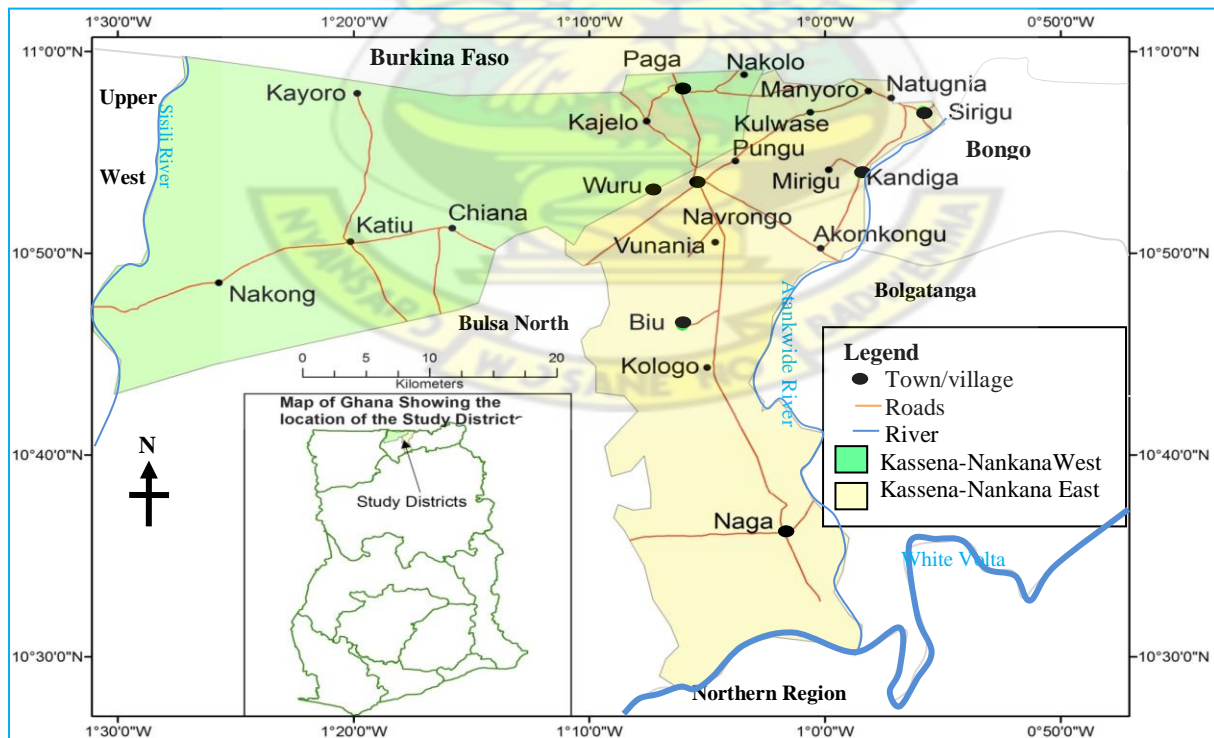
This chapter is structured in two main sections. While the first section presents a summary of the profile of the study district, the second section describes the methodology of the study.

3.2 Kassena-Nankana West District in Perspective

3.2.1 Location, Size and Physical Characteristics

Kassena-Nankana West District is one of the thirteen (13) districts in the Upper East Region of Ghana. It lies approximately between latitude 10.74° and 11.03° North and longitude 0.88° and 01.53° West (KNWDA, 2010). It shares boundaries with Burkina Faso to the North, Bongo District and Bolgatanga Municipality to the East, Kassena-Nankana Municipality to the south, Builsa District and Sissala East District to the West (KNWDA, 2010). Figure 3.1 shows the location of the Kassena-Nankana West District.

Figure 3.1: Map of Kassena-Nankana West District



Source: Adapted from Azabre, 2012.

3.2.2 Topography and Drainage

The topography of Kassena-Nankana West District generally is low-lying with an average height of 1000 metres above sea level (UNDP Ghana, 2010). The landscape is generally undulating with isolated hills rising up to about 300 metres in the western parts of the district (KNWDA, 2010). Notable hills in the District include Fie, (9280 metres), Busono (350 metres), and Zambao (360 metres).

The District is mainly drained by the Sissili River, the Atakwinde River, the Anayere River and the Asibelka River. Some few dug-outs and ponds are also available for livestock rearing, irrigation and domestic purposes. Most of these dug-outs are located in the central part of the District (Paga Area).

3.2.3 Climate and Vegetation

The District forms part of the sudano-sahelian climatic zone which is characterized by the dry and wet seasons. The climate is influenced mainly by two (2) air masses — the North-East Trade winds and the South-Westerlies (Tropical Maritime) (KNWDA, 2010; UNDP Ghana, 2010). The harmattan air mass (North-East Trade Winds) is usually dry and dusty as it originates from the Sahara Desert. During the harmattan periods, rainfall is virtually absent due to low relative humidity, which rarely exceeds 20 per cent and low vapour pressure less than 10 millibar (UNDP Ghana, 2010).

Day temperatures are as high as 42° Celsius (especially February and March) and night temperatures are as low as 13° Celsius (UNDP Ghana, 2010).. The district experiences the tropical maritime air mass between May and October. The average rainfall is 950 mm per annum. The climate is also characterized by high rate of evapotranspiration (UNDP Ghana, 2010).

The vegetation of the district is mainly that of the Sahel and Sudan-Savannah types of vegetations, which consist of open savannah grassland and with deciduous trees (UNDP Ghana, 2010). Some of the most densely vegetated parts of the district can be found along river basins and forest reserves. Examples are the Sissili, Atankwide, Anayere and Asibelika basins, the

Kayoro Forest Reserves. However, the activities of man over the years have affected the original (virgin) vegetation cover. Human activities have negatively affected the vegetation of the district resulting in semi-arid conditions (KNWDA, 2010). The most common economic trees are the shea-nut, dawadawa, baobab, mango, nim and acacia. The low vegetation cover of the area hampers sufficient rainfall thereby reducing underground water supply.

3.2.4 Soil

The District's soil is the "upland soil" mainly developed from granite rocks. Two main soil types can be found in the district. These are the Savanna Ochrosols and the Ground Water Laterites. The Savannah Ochrosols are porous, well drained, loamy, mildly-acidic and interspersed with patches of black or dark grey clay soils. This soil type is suitable for the cultivation of cereals and legumes. The ground water laterites are shallow and low in soil fertility, weak with low organic matter content, and predominantly coarse textured. The ground water laterites are developed over shale and granite. Due to the underlying rock type, they become water-logged during the rainy season and dry up during the dry season, thus causing cemented layers of iron-stone which make cultivation difficult. This would probably affect food security in the District. The Northern and Eastern parts of the District are covered by the Savannah Ochrosols, while the rest of the District is characterized by ground water laterites.

Generally, valley areas have soils ranging from sandy loams to salty clays. These soils have natural fertility but are more difficult to till and are prone to seasonal water-logging and floods. These types of lands which have been considered as marginal have in recent times come under pressure from farming activities due to environmental degradation, climate change, population pressure, among other factors.

4.2.5 Population of the District

The population of the District as indicated by the 2010 Population and Housing Census was 70,667 [Males – 34,747 (49.2%) and Females – 35,920.00 (50.8%)] with a growth rate of 1% and a population density of 70 persons per sq km (GSS, 2013).

3.2.6 Traditional Authority

The District has seven (7) paramountcies; Paga Paramountcy, Chiana Paramountcy, Katiu Paramountcy, Nakong Paramountcy, Kayoro Paramountcy, Mirigu Paramountcy and Sirigu Paramountcy (KNWDA, 2010). The traditional councils handle matters concerning chieftaincy, culture, land and tradition (KNWDA, 2010). They also have a representation at the District Assembly.

3.2.7 Structure of the Assembly

The Assembly is the highest political, administrative and planning authority in relation to provision of local services. It is composed of the following: 46 Unit Committees, 46 Electoral Areas and 68 Assembly members (46 Elected, 20 Appointed 1 District Chief Executive and 1 Member of Parliament) (KNWDA, 2010). The District has one constituency and One Hundred and Twelve (112) Communities (KNWDA, 2010). The District Chief Executive chairs the Executive Committee of the Assembly which runs the day-to-day administration of the Assembly. Eleven sub-committees support the Executive Committee. These are: Finance and Administrative Sub-committee, Works Sub-Committee, Development Planning subcommittee, Justice and Security Sub-Committee and Social Services Sub-Committee. The rest are Tourism Development Sub-Committee, Agricultural Sub-Committee, Health & Sanitation Sub-Committee, Micro and small scale subcommittee, Women and Children subcommittee and Education sub-committee.

At the sub-district level, the District has eleven (11) Area councils out of which seven (7) were functioning (KNWDA, 2010). Apart from Chiana Town council and Mirigu Area council that had office accommodation, the rest had none. Local participation in development processes in the District was hampered by the non-functioning of town/area councils (KNWDA, 2010).

3.2.8 The District Economy

Agriculture

Agriculture is the dominant economic activity in the district. The sector employs over 68.7 percent of the people (Derbile, 2010; KNWDA, 2010). The major crops grown are millet, sorghum, rice, groundnuts, leafy vegetables, cowpea, bambara beans, okro, cotton, tomatoes and

onion. Livestock reared in the district include cattle, sheep, goat, pigs, guinea fowls, fowls and other domestic animals like donkeys. Fish farming involving tilapia and mudfish are quite significant.

Farm sizes are quite small and yields are very low as compared to other parts of the country due in part to poor soils and unreliable rainfall (Derbile, 2010; KNWDA, 2010). There are few dams and dugouts which are being used for dry season farming. This has serious implications for food insecurity.

Manufacturing

The District has no large scale manufacturing industries. It is characterized by small scale food processing, craft manufacturing industries such as smock weaving, pottery and blacksmithing (KNWDA, 2010).

Agro Industry/Processing

Processing of foodstuffs, cash crops and goods are common features of the local economy. The main small scale industrial activities in the District include the following: Shea butter extraction, pito brewing, milling or grinding of millet etc for domestic use, dawadawa processing, weaving and dressmaking, pottery, rice milling and soap making (Derbile, 2010; KNWDA, 2010). Most of these small scale industries are one-man businesses and hardly employ people.

Tourism

The known tourist attractions in the District are: Paga Sacred Crocodile Pond, Paga-Zenga Sacred Crocodile Pond, Nania Sacred Crocodile Pond, Pikworo Slave Camp, Caves at Chiana, Pottery Art Centre at Sirigu, Kukula Shrine at Kayoro, the Fao and Kea-posiga festivals at Paga and Sirigu respectively and Mokeka festival at Kandiga. Apart from the Paga Crocodile ponds and the Pikworo Slave Camps which attract a few tourists, the rest are in dormant states. In general, the tourist sites in the District are highly underdeveloped and constitute a minute source of revenue to the District.

Employment and unemployment

The level of unemployment is very high in the District especially among the youth. Agriculture pursuits dominate the employment scene. Over 68.7 percent of the active population is into agriculture and the unemployment situation is worse during the prolonged dry season when no farming activity can take place (KNWDA, 2010; Derbile, 2010). Dry season gardening is practiced along rivers banks and in communities where there are small-scale dams. This invariably compels most of the youth to migrate to the southern part of the country in search of jobs. Other areas that offer employment opportunities to the people include the public services, retail trade, food processing, pottery and other agro-based processing.

Commerce

Trading and commercial activities in the District revolves mainly around foodstuff, semi-processed food and crafts, livestock and some manufactured goods (KNWDA, 2010). These commodities are sold in the local markets and outside the district. The three (3) day and six (6) day market cycles play a very important role in the local economy (KNWDA, 2010). Commodities traded range from

The main marketing centres in the District are Chiana, Paga, Sirigu, Kandiga, Katiu, Nakong and Kayoro (KNWDA, 2010). Trading with other parts of the country is evidenced by the truck loads of animals and birds as well as foodstuff leaving for the south - in return, traders travel to Techiman, Kumasi and Accra everyday to bring in manufactured goods for sale (KNWDA, 2010). There are trading activities among business persons in Burkina Faso and communities in the district (KNWDA, 2010).

3.2.9 Infrastructure

Roads

The District has a total feeder roads length of 156.9 km. Engineered roads constitute 127.9 km while unengineered ones 29 km (KNWDA, 2013). The above statistics on the District roads show that many more communities are not linked to motorable roads. There is therefore the need to open up more feeder roads and engineer them for easy movement of people and transportation of agricultural produce to the marketing centers.

Telecommunication and Postal Services

Ghana Telecom operates in the District from Navrongo and there are no land line telecommunication facilities in the District (KNWDA, 2013). However, the following mobile phone services are available MTN, Airtel, Vodafone and Tigo. Paga and Chiana are the only towns with postal services.

Energy

The main sources of energy for cooking in the District are fuel wood, charcoal and gas (KNWDA, 2010). Access to gas in the district is rather inadequate; there is no gas station in the District (KNWDA, 2010). People therefore buy gas from Navrongo or Bolga. The District has six fuel stations (all located in Paga) (KNWDA, 2010). The District is connected to the national grid. However over 60% of the communities are not connected to electricity (KNWDA, 2013). Access to electricity in the district would attract agro-based industries which would offer employment to the youth. There is a great potential for the generation and use of solar energy to complement other sources of energy which needs to be exploited.

Water Provision and Sanitation

The District is served with relatively good potable water supply. There are a total of 202 boreholes, 36 hands dug wells and 3 small town water systems in the District (KNWDA, 2013). 70% of the population has access to potable water supply due to recent interventions by both World Vision Ghana and Calabash Foundation in potable water provision (KNWDA, 2013).

Many houses lack toilet facilities and access to institutional latrines is very poor. This results in open defecation which is unhealthy to human, livestock and the environment. Only 12% of the population has access to toilet facilities (KNWDA, 2010).

3.2.7 Socio-cultural issues

Gender issues

Women despite their dominance in terms of numbers are generally disadvantaged as compared to men (KNWDA, 2010). The marginalization of women is embedded in the patriarchal culture of the people where men are gatekeepers and females play a secondary role to their male counterparts (KNWDA, 2010). Men are considered as primary decision makers. Invariably the

dowry system makes the wife the 'property' of her husband thereby giving the man the right to use her as a resource including labour.

Health

The top ten diseases in the district are malaria, ari, skin diseases, diarrhoea, acute eye infection, rheumatism, intestinal worms, hypertension, acute ear infection and UTI (KNWDA, 2013). HIV and AIDS prevalence rate in the district was 2.0% which was higher than the national prevalence rate (KNWDA, 2010; 2013). There are nine (9) health sub-districts from One Hundred and Nine (119) communities in the District (KNWDA, 2010). The District has four (4) health centres and 10 Community Health Planning Services compounds but had no hospital (KNWDA, 2013).

Education

The percentage of students who qualify for Senior High School (SHS) after their BECE exams were highly unsatisfactory; 47.1% in 2009, 45.6% in 2010, 38.6% in 2011 and 39.2% in 2012 (KNWDA, 2013). From the statistics the standards are falling and steps must be taken to arrest the unfortunate situation. However, primary school enrolment has increased from 11,288 in 2011 to 15,373 in 2012 and Kindergarten from 2,276 in 2011 to 4,588 in 2012 mainly due to expansion of the school feeding programme in the District (KNWDA, 2013). However, Junior High School enrolment decreased from 2,871 in 2011 to 2,622 in 2012.

The challenges of the education sector were; inadequate infrastructure, inadequate trained teachers, inadequate teaching and learning materials, lack of access roads to some schools, limited office space for administration staff, encroachment on school lands, absence of computer laboratories, connection of schools to national grid for ICT, etc. (KNWDA, 2013).

Social Interventions

The LEAP programme has also eased the burden of the poor families particularly those in the rural communities. A sum of GH¢ 280,028.00 was disbursed to beneficiaries in 2012 (KNWDA, 2013). A number of the youth (6,925) in the District were recruited for the various modules under the Ghana Youth Employment and Entrepreneurial Development Agency (GYEEDA) (KNWDA, 2013). This reduced the level of youth unemployment significantly. The Ghana

School Feeding Programme has led to an increase in enrolment. A total of 10,442 school pupils were being fed under the programme.

3.3 Methodology of the Study

3.3.1 Introduction

This section describes the logical framework process for realizing the research objectives. It seeks to address issues relating to the type of data that are relevant for the study, what and how data was collected and from whom, as well as how data was analyzed and presented.

3.3.2 Research Design

The purpose of a research design is to make sure that the evidence obtained enables the researcher to answer the research question as unambiguously as possible. There are two main approaches to research; qualitative and quantitative. The qualitative research approach would be employed in this study.

The qualitative approach have received much attention in social science because of its ability to answer the *why* and *how* issues which characterizes much of social phenomenon (Berg, 2001). Unlike quantitative approach that relate to the quantity of things (counts and measures), the qualitative approach relates to the quality of things (Berg, 2001:3). Quality in this context is used to refer to the *what*, *how*, *when*, and *where* of a thing, its essence and ambience (Berg, 2001:3). Qualitative research thus, refers to the meanings, concepts, definitions, characteristics, metaphors, symbols, and descriptions of things.

Qualitative research has many advantages for the study of climate change adaptation. It is concerned primarily with practice and process (*the How*) rather than outcomes or products. In this case, the approach allowed for the analysis of the process of mainstreaming that is taking place in Ghana. It also allowed for the in-depth analysis of the experiences and perceptions of participants concerning climate change adaptation. The approach is ideal for understanding multiple realities, as is the case in climate change phenomenon. With the approach the researcher is the main instrument of data collection rather than some inanimate mechanism involving the

deployment of inventories, questionnaires, or machines. The researcher physically goes to the people, setting, site, or institution to observe or record behaviour and events in their natural setting.

In terms of theory, the qualitative research approach follows the constructivism claims to knowledge (Creswell, 2008:18). The qualitative approach is ideal for the study of climate change adaptation because climate change adaptation issues are descriptive in nature and perceptions and experience of people with regard to the climatic stresses are pertinent for understanding the different modes of adaptation.

In line with the qualitative approach, a cross-sectional case study design was adopted. According to Schel (1992) and Kumekpor (2002:102), the case study method provides a systematic way of assessing events, collecting data, analyzing information and reporting the results. It also enables the researcher to search deeper into the problem being studied and encourages the use of participatory rural appraisal (PRA) tools that have the advantage of facilitating participation and dialogue between researchers and respondents (Kumar, 1999; Owuor, 2010). Bell (2004) has also observed that, the case study research design is appropriate for studies that require in-depth information about a phenomenon within a limited period where a large-scale survey may not produce the true results. These unique qualities of the case study design make it ideal for the analysis of climate change adaptation issues. The use of this method facilitated an in-depth analysis of climate change adaptation initiatives and how they were mainstreamed into development planning in the Kassena-Nankana West District.

The problem about the case study method is that it provides little basis for scientific generalization. The purpose of case study is to provide the basis for analytic generalization, that is, to expand and generalize theories. To improve upon reliability and validity of findings which may affect generalization as a result of personal biases, data was collected from different sources; from documentary sources such as reports and publications, through interviews, discussions and observation, for the purpose of triangulation.

3.3.3 Units of Analysis

Unit of analysis or unit of statistical analysis refers to the individual units about which or whom descriptive or explanatory statements are to be made (Mugenda and Mugenda, 1999). This may include household heads, voters, students, institutions and so on. In this study the unit of analysis were the District Planning and Coordinating Unit (DCPU) of the Kassena-Nankana West District, the District Budget Officer, District Finance Committee, and district directors of DADU, Ghana Health Services, Ghana Education Service, Forestry Commission, area council members, NADMO, NGOs, Town and Country Planning Department, World Vision, ORGIIS, Water Resources Commission and the Environmental Protection Agency (EPA).

3.3.4 Key Variables

In a research, it is essential that concepts used should be operationalized in measurable terms so that the degree of variation in respondents' understanding is reduced if not eliminated. The techniques about how to operationalize concepts and knowledge about variables play an important part in reducing subjectivity. A variable is simply a property that assumes different values. It is also an image, perception or concept that can be measured, hence capable of taking on different values (Kumar, 1999: 47; Mugenda and Mugenda, 1999:11). Key variables in this study are outlined in Table 3.1

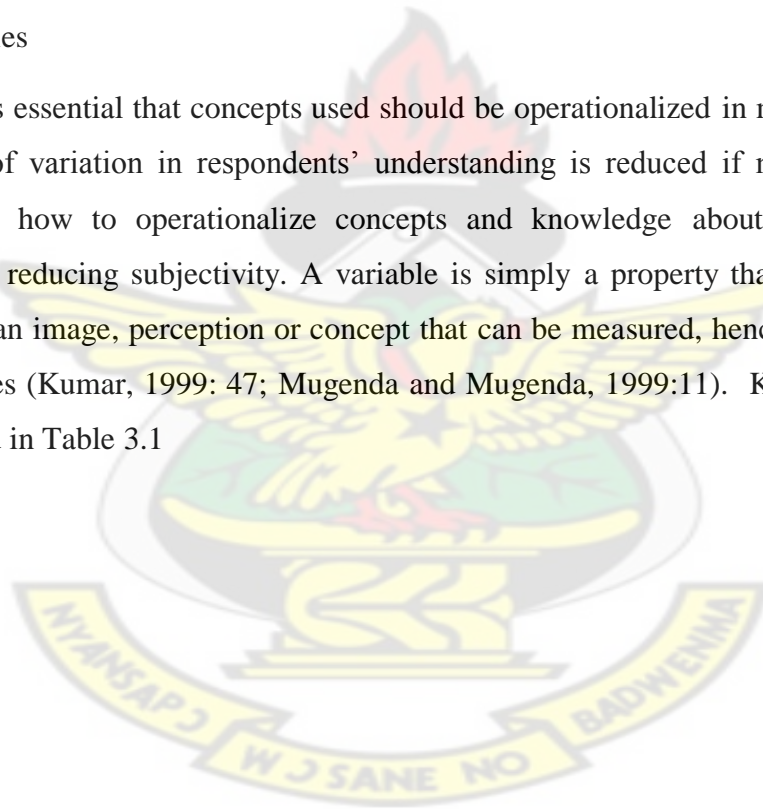


Table 3.1 Key variables of the study

Variable	Brief Description	Units of analysis	Methods of Data Collection	Purpose
Exposure	This involves identifying key climate change related hazards/stressors that occur in the District	<ul style="list-style-type: none"> - District Assembly Staff (District Planning Officer, District Coordinating Director, District Finance and Budget Officers) - Departmental/institutional Heads - Town and Country Planning Department - District Environmental Sanitation Unit - Water Resources Commission - EPA - NADMO - Forestry Commission - Area Councils 	<ul style="list-style-type: none"> - In-depth interviews (IDIs) - Focus Group Discussions (FGDs) - Direct observation - Secondary data; review of reports, MTDP 	To determine the most occurring climate change related stressors/hazards
Sensitivity	This assesses the degree to which the critical sectors of the District such as agriculture, water resources, infrastructure and explores the general effects of climate change stressors/hazards on the District	<ul style="list-style-type: none"> - District Assembly Staff (District Planning Officer, District Coordinating Director, District Finance and Budget Officers) - Departmental/institutional Heads - Town and Country Planning Department - District Environmental Sanitation Unit - Water Resources Commission - EPA - NADMO - Forestry Commission - Area Councils 	<ul style="list-style-type: none"> - In-depth interviews (IDIs) - Focus Group Discussions (FGDs) - Direct observation - Secondary data; reports, MTDP 	To determine how sensitive the District is to climate change hazards/stressors

Adaptive Capacity	To analyze the resources available for adaptation. Six (6) types of resources were analyzed; human, social, physical, natural, financial and political capital.	<ul style="list-style-type: none"> - District Assembly Staff (District Planning Officer, District Coordinating Director, District Finance and Budget Officers) - Departmental/institutional Heads - Town and Country Planning Department - District Environmental Sanitation Unit - Water Resources Commission - EPA - NADMO - Forestry Commission 	<ul style="list-style-type: none"> - In-depth interviews (IDIs) - Focus Group Discussions (FGDs) - Direct observation - Secondary data; reports, MTDP 	To assess the ability of the District to adapt to climate change and thus, determine the vulnerability situation of the District
Climate change adaptation initiatives	These include policies, programmes and projects aimed at facilitating adaptation.	<ul style="list-style-type: none"> - District Assembly Staff (District Planning Officer, District Coordinating Director, District Finance and Budget Officers) - Departmental/institutional Heads - Town and Country Planning Department - Water Resources Commission - EPA - NADMO - Forestry Commission - Area Councils 	<ul style="list-style-type: none"> - In-depth interviews (IDIs) - Focus Group Discussions (FGDs) - Direct observation - Secondary data; reports, development, MTDP 	To obtain information about the initiatives and measures put in place to address current and potential climate change impacts.
Mainstreaming climate change	This involves strategies for integrating climate change adaptation issues into development policies and plans	<ul style="list-style-type: none"> - District Medium Term Development Plans - District Annual Action plans - District Budgets and Expenditure Statements (Trial balance) - Spatial vulnerability maps - Town and Country Planning Department 	<ul style="list-style-type: none"> - Secondary Data; reports, MTDP - interviews (IDIs) - Focus Group Discussions (FGDs) 	To ascertain the progress made so far in mainstreaming climate change adaptation into development plans and budgets

		<ul style="list-style-type: none"> -Forestry Commission -District Water and Sanitation Team -Area Councils 		
Prospects for mainstreaming climate change adaptation	This involves identifying opportunities for mainstreaming adaptation in plans and budgets	<ul style="list-style-type: none"> - District Assembly Staff (District Planning Officer, District Coordinating Director, District Finance and Budget Officers) - Departmental/institutional Heads - Town and Country Planning Department - District Environmental Sanitation Unit - Water Resources Commission - EPA - NADMO - Forestry Commission 	<ul style="list-style-type: none"> - In-depth interviews (IDIs) - Focus Group Discussions (FGDs) 	To assess the prospects for mainstreaming adaptation district level plans and budgets.
Challenges to mainstreaming climate change adaptation	This meant identifying the barriers to mainstreaming climate change adaptation. What is not working well in terms of mainstreaming at district level and why?	<ul style="list-style-type: none"> - District Assembly Staff (District Planning Officer, District Coordinating Director, District Finance and Budget Officers) - Departmental/institutional Heads - Town and Country Planning Department - District Environmental Sanitation Unit - Water Resources Commission - EPA - NADMO - Forestry Commission - District Water and Sanitation Team 	<ul style="list-style-type: none"> - Focus Group Discussions (FGDs) - In-depth interviews (IDIs) – interview guides 	To identify key challenges in the mainstreaming of climate change adaptation as a basis for determining what needs to be done to facilitate the process

Source: Author's construct, 2014

3.3.5 Sampling Design and Sampling Procedure

Sampling design refers to the methods, approaches and procedures involved in selecting a representative sample for a study. Kumar (1999:152) have identified three sampling designs namely, random or probability sampling techniques, non-random/non-probability sampling techniques and mixed sampling techniques. The main distinctive feature of probability sampling design is that, each element in the population must have an equal and independent chance of selection. The use of the random sampling design depends to a large extent on the researcher's access to information about the study population (Kumar, 1999:152). Conversely, the non-probability sampling designs do not follow the theory of probability in the choice of elements in the sampling population. Non-random sampling is used when the number of elements in a population is either unknown or cannot be individually identified (Kumar, 1999:152).

In line with the qualitative approach and the case study design chosen for the study, non-probability sampling design was used for selecting respondents for the study. Thus, purposive sampling was the main sampling technique used for the selection of respondents for the study.

Purposive Sampling Technique

Purposive sampling technique was used to select heads of institutions, district assembly staff, Area Council executives/members, heads of decentralized departments/agencies and NGOs in the District. These included;

1. District Assembly Staff;
 - District Coordinating Director,
 - District Planning Officer,
 - The District Budget Officer,
 - The District Finance Officer
 - District Building Inspectorate
 - Presiding Member
 - Area Councils
2. Decentralized Departments
 - District Agricultural Development Unit (DADU)
 - Ghana Health Services

- Ghana Education Service
 - Town and Country Planning Department
3. Governmental Organizations/Agencies
- Environmental Protection Agency
 - National Disaster Management Organization
 - Forestry Commission
 - Water Resources Commission
 - Environmental Sanitation Unit
4. Non-governmental Organizations
- World Vision Ghana
 - ORGIIS

Table 3.5 Summary of sampling techniques

Sample Unit	Sample Size	Sampling Technique
District Assembly Staff	6	Purposive Sampling
Area Councils	7	Purposive Sampling
Decentralized Departments	4	Purposive Sampling
Governmental Organizations/agencies	5	Purposive Sampling
Non-governmental Organizations	2	Purposive Sampling
Total	24	

Source: Author's Construct, 2014

3.3.6 Sources of Data

Both secondary and primary data were collected for the study. Secondary data for the study were sourced from District Medium Term Development Plans, District Annual Action Plans and budgets as well as monitoring/progress reports. Others were development plans and reports from decentralized departments/agencies. In addition, data was sourced from books, journals and internet archives. The methods of collecting primary data are discussed in the next sub-section (3.3.7).

3.3.7 Methods of Data Collection

The credibility of a researcher depends on the instruments or tools of data collection. Therefore, the study meticulously selected and used Focus Group Discussions (FGDs) and In-Depth Interviews (IDIs) as well as direct observation to collect primary data.

In-depth Interviews (IDIs)

In-depth Interviews were held with district assembly staff, heads of decentralized departments, governmental organizations/agencies and NGOs. The purpose of the IDIs was to obtain qualitative data on respondents' knowledge, perceptions and experiences about climate change adaptation as well as the adaptation measures of the district and the extent to which the measures were mainstreamed to enhanced sustainable development.

Focus Group Discussions (FGDs)

Focus Group Discussions (FGDs) were held with area council members. Seven FGDs were conducted involving all the area councils that were functional at the time of the study. The average number of participants for the FGDs was five (5). The FGDs were useful in obtaining data on community level impacts, challenges and adaptation measures as well as the efforts made in mainstreaming.

Direct Observation

This was a field observation of the effects of climate change on the District. Direct observation was used to obtain data on the sensitivity of agriculture, water resources and infrastructure to climate change impacts and extremes. The researcher was able to observe and take pictures of the effects of drought/dry spell on agriculture as well as the impacts of climate change on the Atankwide and Anayere rivers. Also, direct observation was used in the field to gather first hand information about adaptation initiatives pursued in the District.

3.3.8 Method of Data Analysis and Presentation

Data analysis plays an important role in research by bringing order, structure and meaning to the gamut of data collected. Because the study is mainly a qualitative research, qualitative data was collected from the field from both primary and secondary sources.

Qualitative data analysis is non-empirical and non-statistical. It seeks to make general statements on how categories or themes of data are related. As a result, content analysis was used for the analysis of data. Content analysis is the systematic analysis of the content of a text (i.e who says what, to whom, why, and to what extent and with what effect) in a quantitative or qualitative manner (Bhattacharjee; 2012:116). In content analysis, researchers examine artifacts of social communication such as written documents or transcriptions of recorded verbal communications (Berg, 2001). From this perspective, photographs, videotape, or any item that can be made into text are amenable to content analysis.

The deployment of content analysis in this study allowed the researcher to unitize or identify and apply rules to divide each interview script into segments or chunks that can be treated as separate units of analysis. For instance, adaptation measures identified during the IDIs served as separate units or themes for analysis. Each theme or unit was then analyzed qualitatively, to determine which themes occur most frequently, in what contexts, and how they are related to each other. In addition, specific quotations of responses were captured under the themes for the sake of emphasis.



CHAPTER FOUR

DATA ANALYSIS AND PRESENTATION

4.1 Introduction

This chapter presents the analysis of field data and discussing of findings. The Chapter is structured in six (6) sections. Section two discusses the respondents' perspectives on climate change, section three (3) discusses issues relating to vulnerability and climate change adaptation, and section four (4) discusses climate change adaptation initiatives in the District. Section five (5) and six (6) examine the mainstreaming of climate adaptation into development planning, and the challenges and prospects for mainstreaming climate change adaptation into development planning respectively.

4.2 Perspectives on Climate Change

Climate change impacts affect all facets of life. This idea was well acknowledge by all respondents in the Kassena-Nankana West District. However, respondents' understanding of climate change differed markedly. At the institutional level, four out of the sixteen heads of decentralized departments/agencies interviewed had attended workshops/conferences on climate change and therefore had knowledge about climate change. This notwithstanding, they understood climate change largely as an environmental issue.

Though, it was understood that climate change impacts are pervasive, some departments particularly Ghana Education Service and Ghana Health Service felt that they had no direct contribution to its mitigation or adaptation. The response they gave was simply "We have nothing to do with climate change".

This attitude towards climate change represents a challenge to adaptation and the mainstreaming of climate change into development planning. It also implies that, though, climate change has been included in the Ghana Shared Growth and Development Agenda (GSGDA) as a cross-cutting issue, it is yet to be properly understood and given priority attention at the local level. As argued by The World Bank Group (2011), the success of adaptation to climate change will largely depend on the performance of local institutions. Therefore, it is imperative to raise awareness about climate change and engender positive attitudes towards adaptation.

The understanding of area councils about climate change was equally problematic. Translating the concept climate change into the local languages was a problem. Climate change could not be found in both Kasem and Nankam (the Kassenas speak Kasem while the Nankanas speak Nankam – a dialect of Gurune) vocabularies. Consequently, climate change was understood in terms of climate change stressors such as changes in temperature and rainfall patterns and the occurrence of floods and storms among others as well as their effects. Thus, the knowledge of the councillors about climate change was based on their experiences and observations about the elements of the weather.

Using changes in rainfall to describe climate change, they indicated that the first rains used to come in March or April. Then, farmers prepare the land and carry their manure/compost out to the fields and sow (wet) fields (*boɔrɔ* in Nakam), then, the actual sowing season starts in May. But now the sowing season starts in June and sometimes July. They also observed that, in the past, the weather used to be very cold around November to January at the eve of the harmattan and in February, the harmattan winds come strong. They indicated that the response to greetings in the morning, that is, *la fu ɔrɔ* (meaning ‘and your cold’) attest to the fact that the temperature was much cooler than it is now.

Even though, the respondents (the councillors) could not measure changes in climate statistically, their observations and experiences about the climate confirms conventional statistics from studies by Minia (2004, as cited in Yaro, 2010), The World Bank Group (2011) and Stanturf et al, (2011) that the climate of Ghana has changed significantly over the past 30 years .

4.3 Vulnerability and Climate Change Adaptation in the Kassena-Nankana West District

4.3.1 Introduction

This section assesses the vulnerability situation in Kassena-Nankana West District. The assessment was based on the IPCC’s framework for vulnerability analysis which expresses vulnerability as a function of exposure, sensitivity and adaptive capacity. Thus, the basis for understanding the vulnerability of a system to climate change involves the understanding of those three (3) essential components. Therefore, the section starts by analysing each of the three components of vulnerability and ends by giving a summary of the vulnerability situation in the District.

4.3.2 Exposure to climate Change Hazards/stressors

The Kassena-Nankana area and indeed most parts of Northern Ghana is a climate risk and a disaster prone zone. Respondents of the study identified a number of climate change related hazards/stressors that the District is exposed to and have been experiencing. These include droughts or dry spells, high temperatures, windstorms and heavy rains/floods.

According to DADU, ORGIIS and the councillors, drought and dry spells have been a common phenomenon in the District. In Sirigu and Kandiga area councils, respondents acknowledged that even though drought had been with them since their childhood days, the situation has now gone worse. Their views were captured in the Box 4.1.

Box 4.1: Some views of respondents' about drought

Last year I sowed early, the crops germinated and were looking good, I started weeding, and for about almost a month, no rain came, all my crops withered and died.

It seems the person in-charge of the distribution of water in God's house has not been performing his duties well; at the start of the season he would open the water, then we get the first rains and go out with our seeds to sow with joy. Then he goes to sleep and there is drought, and our crops die. When our cry reaches him and he wakes up from his slumber, that is somewhere in August or September, he opens all the waters and goes to sleep again and there is flooding and all that is left of our crops die.

The rains over the last few years have become discriminatory and very funny. You can imagine, it will sometimes rain on one part of my farm and leave the other, or in Kandiga Longo and leave Kandiga Bembisi, or in Mirigu and leave Sirigu. In the past, the rains used to be universal, that is, if it rains every part gets its due.

Source: Author's field survey, May 2014

Respondents also equally observed changes in temperatures over past few years. They used their experience about temperatures during the cold and warm seasons to describe changes in temperature. They observed that, the warmest period of the year in the area is between March and July and the coldest months are November, December and February. They recounted that, in the past (10-30 years ago), the weather used to be very cold especially in November, December and January. Households used to gather crop residue after the harvest to create bonfire to warm themselves in the morning. They explained that even though the rooms in those days had small or no windows and relatively small doors, households had to still keep live fire in their rooms at night and dawn to keep themselves warm. They also indicated that the Nankana greeting in the morning attest to the fact that the temperature used to be very cold. This is expressed in Box 4.2. The observations of the respondents were that over the past few years, the cold season often come and passes without anyone noticing the cold.

Box 4.2 Greetings in Nankam

The common greeting in the morning among the Nankana people is

Fu bulika, meaning; *your morning* and the response is,

La fu ɔɔrɔ, meaning *and your cold*.

Source: Author's field survey, May 2014

It was also observed that the warm season have also become even more warmer such that, it is often difficult to sleep at night even if one lies at the top of his building. Respondents also noted that although, storms and floods are a common phenomenon in the area, the frequency with which they occur have increased considerably.

4.3.3 Sensitivity to Climate Change Hazards/stressors

Sensitivity to climate change describes the socio-economic or ecological (Stanturf et al, 2011) and the biophysical and social (O'brien, 2004) responses to climate change related hazards. As observed by Easterling, Hurd and Smith (2004), the characteristic of a system determines its sensitivity to hazards. The study analyzed the sensitivity of the following key sectors of the District to climate change; agriculture, water resources and social infrastructure.

Sensitivity of Agriculture to climate change

Agriculture employs 68.7 percent of the people in the District (Derbile, 2010; KNWDA, 2013). Thus, it is the main livelihood of the people. About 80 percent of farmers grow food crops as their main source of livelihood (Derbile, 2010). Farming in the District is rain dependent as irrigation infrastructure and other advance techniques of farming were virtually absent.

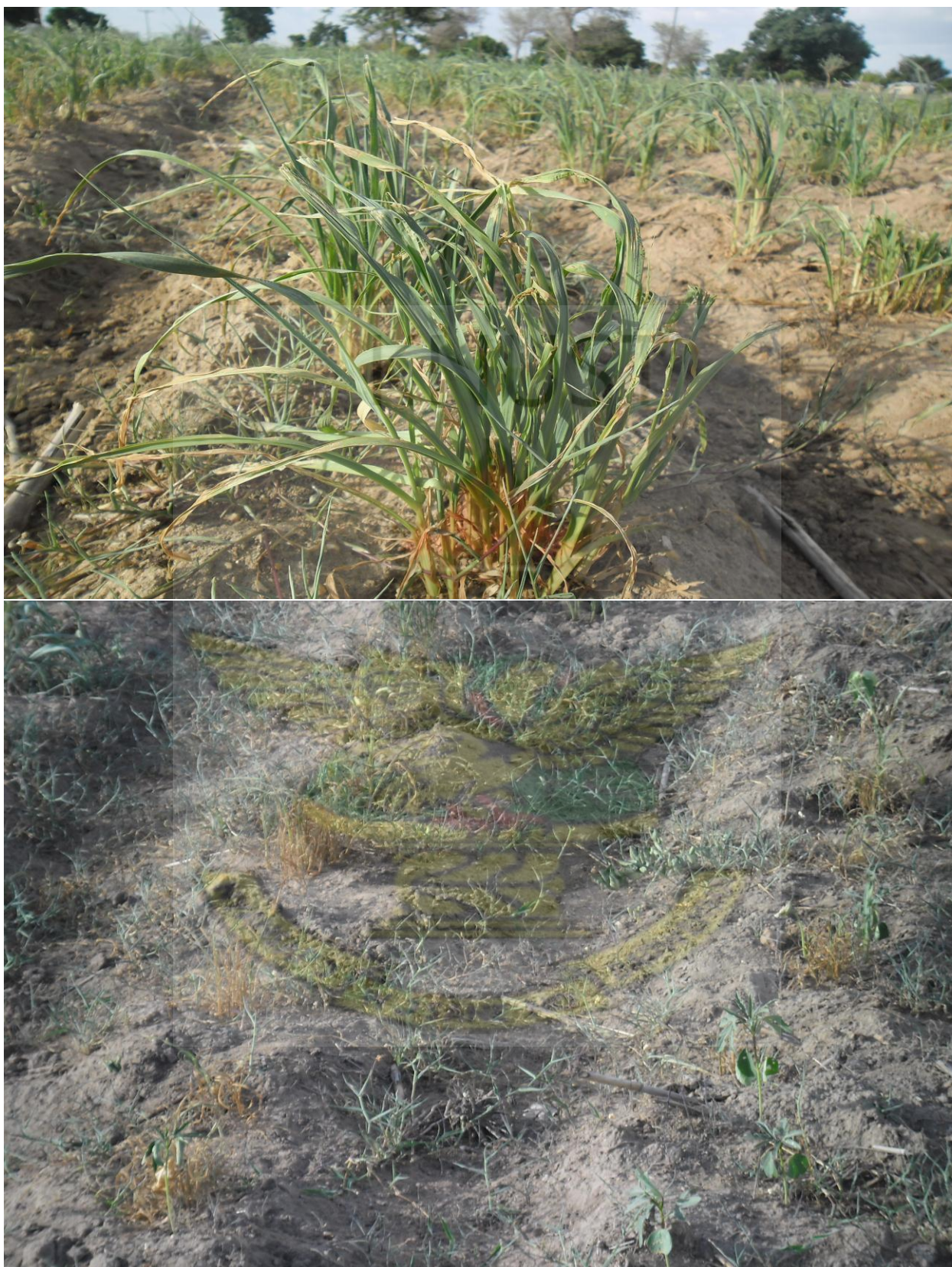
The study found that, the agricultural sector was greatly affected by climate change related hazards. In the crop sub-sector, erratic rainfall has created uncertainties and a systemic change in the cropping calendar. DADU has indicated that distribution of rainfall is often poor such that if the farmers sow early, they hit a dry spell which destroys the crops, and if they sow late they hit floods. As shown in Plate 4.1 and Plate 4.2, farmers who sowed early this year (May, 2014) at the time of the study were counting their losses as they hit a dry spell which destroyed their crops. Respondents in the focus group discussions with the area

councils noted that, there was no safe haven for sowing crops. A participant in a focus group discussion in Mirigu said; “If you crop in upland areas, you suffer the peril of high erosion or drought, and if you crop in lowlands you suffer the peril of floods and water-logging”. In addition, respondents indicated that the changes in rainfall patterns also facilitated the spread of crop pest and diseases as shown in Plate 4.3

Statistics from DADU indicate a decline in the production of two major food crops in the District, millet and sorghum. For instance, the production of millet and sorghum in 2006 was 10,100 metric tonnes and 19,785 metric tonnes respectively. These declined to 1,040 metric tonnes and 1,450 metric tonnes respectively in 2012 which confirms Derbile (2010) finding that crop production has decline considerably in the area. Discussions with the area councils and data from DADU indicate that many households are shifting to livestock rearing as an alternative to the highly unproductive crop sub-sector. Statistics from DADU indicate that annual production of livestock increased from 506, 004 units in 2006 to 642,545 units in 2012.



Plate 4.1: Dead/ withered crops on a farm in Kandiga



Source: Author's field survey, May 2014

Plate 4.2: Seed failure on a farm due to drought



Source: Author's field survey, May 2014

Plate 4.3: A millet farm destroyed by insects

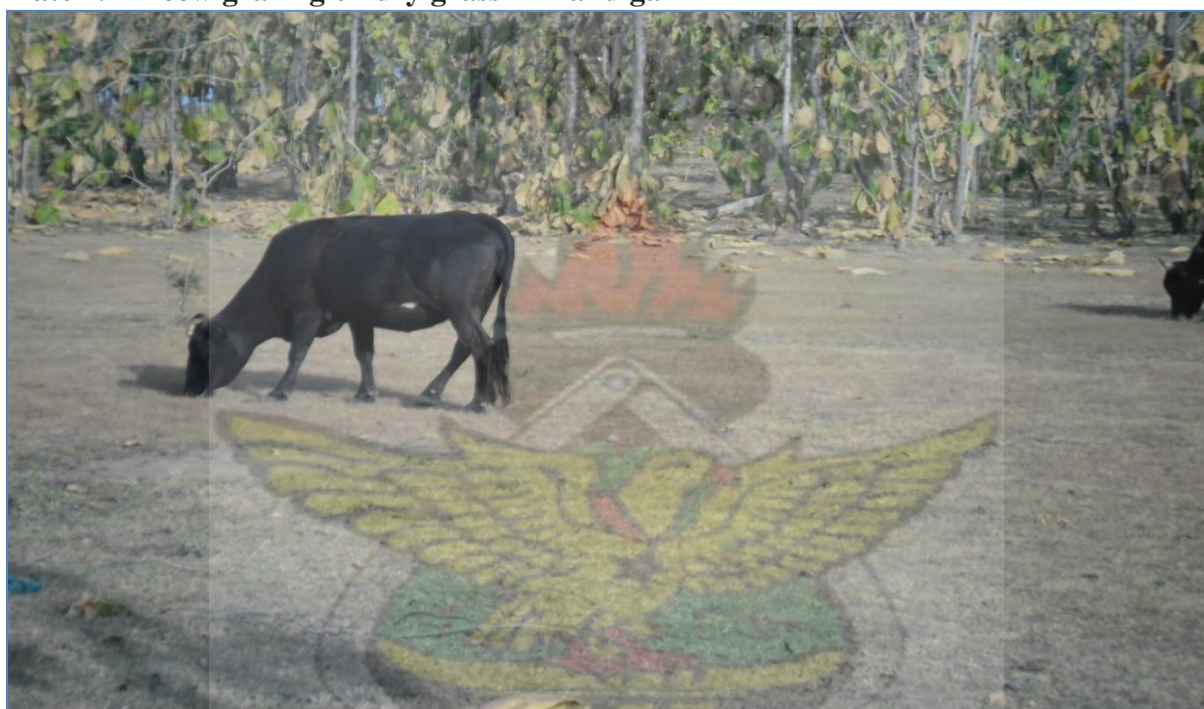


Source: Author's field survey, May 2014

Although some households were adopting livestock rearing as an alternative to the declining crop sector, the livestock sub-sector could not be considered climate proof either. Participants at the focus group discussions with area councils particularly in the eastern part of the District described the effects of changes in climatic conditions on their livestock. It was noted that,

there were numerous complaints of animals (particularly sheep and cattle) getting lost. This was because, the grasses (pastures) that grew from the first rains had dried up in the dry spell that hit the area, causing scarcity of pasture as shown Plate 4.3. It was discovered later that because of scarcity of pasture, the animals migrated to the areas along the Atankwide River for feed. Therefore, at the time of the data collection, it was common for households in the Sirigu and Kandiga area to travel to the areas along the Atankwide River (particularly the Sumbrungo area) in search for their lost animals.

Plate 4.4 A cow grazing on dry grass in Kandiga



Source: Author's field survey, May 2014

Sensitivity of Water Resources to Climate Change

Located within the White Volta Basin, the Kassena-Nankana West District is drained by a number of rivers and streams which are tributaries of the White Volta. The District is mainly drained by four rivers; the Sisili River, the Asibelika River, the Anayere River and the Atankwide River. Apart from these rivers, the study also identified dams/dugouts, wells and boreholes which served the water needs of people in the District.

Field observations and interviews revealed that, water resources in the District were under the threat of climate change. Participants in focus group discussions in Sirigu, Mirigu and Kandiga area councils noted that the Atankwide and the Anayere rivers used to have water all year round but have now been dried up. They attributed the drying up of the rivers to farming

activities along the rivers particularly dry season farming. They explained that dry season farming has been adopted as a means of dealing with low crop yield during the major season. They also noted that migration down south during the off-farming season has also proven to be counter-productive in recent times because they get nothing from there. Consequently, their only option is dry season farming along the rivers. The process involves digging trenches in the bed of the river for water which is then pumped via water pumping machines to farms located at the banks of the rivers. As shown in Plate 4.3 and 4.4, the activities are destructive to the rivers.

Plate 4.5 Destructive farming activities along the Anayere River



Source: Author's field survey, May 2014

Plate 4.6: Destructive farming activities along the Atankwide River



Source: Author's field survey, May 2014

According to DADU, it was not only surface water alone that was affected, but also underground water. It was explained that, the normal expectation is that in a 30 mm rainfall, about 20 percent goes into run off and 10 percent goes into the soil to recharge underground water. This normally happens when the rainfall is gentle and is distributed over a reasonable time. On the contrary, it was observed that the nature of rainfall in recent times is such that, 30 mm of rainfall can occur just within 10 minutes. In this case, less than 5 mm is likely to go to the soil whereas about 25 mm will go as run-off. This phenomenon it was noted represents a threat to water security in the District. Currently, assistance from World Vision Ghana, Calabash Foundation and the Government of Ghana through District Water and Sanitation Agency has increased the access to potable water from 60.4 percent in 2011 to 70 percent in 2012. The main source of water for drinking was boreholes. DADU argued that the decline in ground water would lead to the drying up of some of these boreholes. DADU noted that, already some boreholes have dried up while a significant number are not efficient. According to DADU, an efficient borehole takes 40 pumps to fill a size 40 bucket, but most of the boreholes in the District, takes about 60 pumps to fill a size 40 bucket which was an indication that underground water was getting low. DADU equally observed that, well over 60 percent of dams and dugouts in the District were not able to contain water all year round due to human and environmental factors (climate change).

Sensitivity of Social infrastructure to climate change

The sensitivity of social infrastructure to climate change hazards was well observed in the study. In the housing sector, the impact of heavy rainfall on the local houses was quite pronounced. Local houses which constitute a majority of housing in the District are built with mud and roofed with local materials or iron sheets. These buildings are susceptible to heavy rainfall and often collapse during the rainy season. Households usually rebuild or maintain collapsed or damaged buildings during the dry season. In addition, public buildings particularly school buildings had also suffered from frequent destruction by windstorms. According to the Ghana Education Service, between 2010 and 2013, about seven (7) schools have had their roofs ripped off by windstorms. Also, affected were culverts and feeder roads which were damaged by flood waters as shown in Plates 4.5 and 4.6.

Plate 4.7: A 3-classroom block and a toilet building destroyed by windstorms in Sirigu Primary



Source: Author's field survey, May 2014

Plate 4.8: A Climate Change awareness billboard destroyed by windstorms & portion of a feeder road washed away by flood waters



Source: Author's Field survey, May 2014

Plate 4.9: Parts of a house in Mirigu destroyed by heavy rains



Source: Author's field survey, May 2014

4.3.4 Adaptive Capacity

The study analyzed the adaptive capacity of the District using the six types of resources identified by Dazé, Ambrose and Ehrhart (2009) for assessing adaptive capacity. The results are summarized in Table 4.1.

Table 4.1: Adaptive capacity in Kassena-Nankana West District

Type of Resource	Components	Situation in Study Area	Spatial Dimension	Remarks
Human	Knowledge of climate risks	<ul style="list-style-type: none"> • No disaster risk assessment information • No early warning systems • Lack of capacity to analyze risks 	District wide	<ul style="list-style-type: none"> • Low knowledge of climate risks • Poor response to climate change
	Technology	<ul style="list-style-type: none"> • Limited knowledge of improved farming methods: Soil conservation skills, agro-forestry, use of improved seeds and breeds • One guinea fowl breeding center established in 2012 • Slow adoption of improved methods • High use of indigenous technologies 	District wide	Improved technology not available/adopted
	Good health for labour	<ul style="list-style-type: none"> • Health facilities not adequate • Shortage of critical health staff. E.g doctors • 72% NHIS coverage in 2012 • Malaria control programmes available 	District wide	Health services available
Social	Women's savings and loans groups	<ul style="list-style-type: none"> • Women's groups exist for social support only • Limited micro-credit exist for women's groups 	District wide	Limited access to loans

	Farmer-based organizations	<ul style="list-style-type: none"> • Only dry season tomato FBOs exist • No active FBOs 	District wide	No active FBOs
	Stable and effective institutions	<ul style="list-style-type: none"> • weak district level institutions • inactive local/community level institutions • NGOs assistance available 	District wide	Weak District level institutions Inactive local level institutions
Physical	Irrigation infrastructure, seed and grain storage facilities	<ul style="list-style-type: none"> • No irrigation infrastructure • No grain storage facilities 	<ul style="list-style-type: none"> • No irrigation infrastructure in East and West • District wide 	<ul style="list-style-type: none"> • Irrigation infrastructure not available • No storage facilities
	Agriculture information centers	<ul style="list-style-type: none"> • No agriculture information center 	<ul style="list-style-type: none"> • District wide 	<ul style="list-style-type: none"> • No agriculture information centers available
Natural	Reliable water source	<ul style="list-style-type: none"> • Rivers drying up • Water deficits for agriculture • 70% access to safe water 	District wide	Inadequate water for agriculture
	Productive land	<ul style="list-style-type: none"> • High soil erosion • Increasing desertification • Soil nutrient depletion • Over-cultivation • Overgrazing 	District wide Particularly the East	Low productivity of land

Financial	Micro-insurance	<ul style="list-style-type: none"> • No micro-insurance 	District wide	No micro-insurance
	Diversified income sources	Limited alternative income sources	District wide	Limited alternative livelihoods
Political Capital	Policies and plans (DMTDP),	<ul style="list-style-type: none"> • Policies favour poverty reduction • No local level policies or plans on adaptation 	District wide	No policies targeting adaptation
	Institutions and power structures	<ul style="list-style-type: none"> • All state institutions (District Assembly, decentralized departments/agencies) located in the Central Zone • Weak institutional capacity at the district level: lack of logistics, inadequate staff, inadequate funds • Area councils inactive 	District wide	Weak institutional capacity Power structures support equitable development

Source: Author's Field survey, May 2014

Table 4.1 suggest that the adaptive capacity of the District is weak. For instance, disaster risk programmes and early warning systems were absent in the District. In addition, the capacity of staff to analyze risks was also weak. Consequently knowledge about climate change risks was low.

4.3.5 Conclusion

The data suggests that, the vulnerability of Kassena-Nankana West District to climate change is high. This finding is not peculiar to this study as Gyampoh, Idinoba and Amisah (2008), Dietz et al (1999), Yaro (2010), Stanfurt et al (2011) and The World Bank Group (2011) have noted similar levels of vulnerabilities in the three (3) regions of the north. In particular, the study found that exposure to climatic change hazards/stressors such as droughts or dry spells, high temperatures, windstorms and heavy rains/floods was high in the Kassena-Nankana West District because the frequency of their occurrences have increased and their effects on lives and livelihoods have been pervasive. The District was particularly vulnerable to climate change because the key sectors of the District such as agriculture, housing, water resources among others, are highly sensitive to the identified climate change hazards or stressors. The agriculture sector of the District which is dominated by crop farming was highly sensitive to changes in rainfall because the sub-sector was rain-dependent.

Yohe and Tol (2002), Gallopin (2006) and Adger *et al* (2007 as in Fellman, 2012) have argued that the vulnerability of a system to climate change impacts depends primarily on the adaptive capacity of the system. In the view of Dazé, Ambrose and Ehrhart (2009), adaptive capacity is determined by the access to and control over a number of resources including, human, physical, natural, social, financial and political. An assessment of these resources in the District revealed that the District lacked the needed resources to adapt to climate change. Thus, the adaptive capacity of the District is low.

In the wake of high exposure and sensitivity to climate change hazards/stressors and low adaptive capacity the vulnerability situation in the District from the viewpoint of the vulnerability-security continuum poses a state of socio-economic insecurity (TERI, 2006). According to Fellman (2012), a system is vulnerable to climate change if it is exposed to and sensitive to climate change and at the same time has low capacity to adapt. This finding is consistent with the findings of Yaro (2010), Dyoulgerov et al (2011) and Stanturf et al (2011) that say that vulnerability to climate change impacts and extremes are highest in the three (3) regions of the north. The results also confirm Nelson and Agbey (2005) that the adaptive capacity of MMDAs to climate change in Ghana is low.

4.4 Climate Change Adaptation Initiatives

4.4.1 Introduction

This section discusses initiatives pursued in the District in response to climate change related hazards/stressors. The initiatives discussed in this section include all the adaptation projects pursued by communities, organisations and the District Assembly. These initiatives include integrated water resources management practices, integrated soil and land management, promotion of alternative livelihoods, improved seed varieties and animal breeds, education and awareness creation, and natural vegetation management.

4.4.2 Integrated Water Resources Management

The purpose of the integrated water resources management is to promote changes in practices which are considered fundamental to improved water resources management. The process is comprehensive, participatory and involves planning and implementing water resource management and developing initiatives that cater for the socio-economic needs of people while ensuring the protection of ecosystems for future generations. Initiatives regarding integrated water resources management in the Kassena-Nankana West District were the buffer zone system and woodlots.

The buffer zone system involves creating a buffer or barrier between a water body (river or dug-out) and farms. This usually involves the planting of trees along the river bank or within the catchment area of the dug-out or dam. The trees serve as a break or buffer between the river or water body and farms. This is to help maintain the stability of the river to retain water. The trees may be fruit trees especially mango trees or woodlots such as acacia or teak trees. Be they fruit trees (for food) or woodlots (for fuel wood), the communities benefit from them and work to maintain them. The key integrated water resources projects the study identified were the mango plantation within the catchment area of the Kandiga Dam (Plate 4.10) in the eastern part of the District and the Kazugu Dam (Plate 4.11) at Navio in the central part of the District.

Plate 4.10: Kandiga Mango Plantation



Source: Author's field survey, May 2014

The Kandiga Project is an initiative of the Kassena-Nankana West District Assembly in partnership with the Kandiga Chief and the Aziduma Community in Kandiga on a shared arrangement. Under the arrangement, the Assembly supplied the mango seedling and fenced the area. The community supplied labour for planting as well as maintenance of the seedlings. The fruits are to be shared between the Assembly the community according to an agreed criteria. The project expected to generate income for both the Assembly and the community as well as maintain the dam. This makes the project comprehensive, integrative and participatory, thus, conforming to the principles of the integrated water resources management.

The Buru-Kazugu project is a community based project funded by the Environmental Protection Agency (EPA), the Ghana Environmental Management Project (GEMP) and the Canadian International Development Agency (CIDA). As shown in Plate 4.11, the project involves the planting of trees as well as the provision of portable water.

Plate 4.11: The Buru-Kazugu project



Source: Author's field survey, May 2014

The study found most of the integrated water resources management projects to be incremental, piece-meal and inadequate given the magnitude of the climate change problem. For instance, all the rivers in the District were heavily affected by farming activities (particularly dry-season farming). For instance, the Atankwide River and the Anayere River in the Eastern part of the District where irrigation facilities were virtually absent have been badly damaged by farming activities as is shown in Plate 4.12.

Plate 4.12: Destructive dry season farming activities along the Atankwide River



Source: Author's field survey, May 2014

4.4.3 Education and awareness creation

Education and awareness programmes were organized by organizations both at the District and regional levels on environmental awareness/climate change. These include the EPA's annual Environmental Education and Awareness Creation Programme with emphasis on drought and desertification. In 2013, three (3) communities in the Kassena-Nankana West District were sensitized with over 161 people benefiting. The EPA sensitization activities also included the formation and training of environmental clubs in Senior High Schools as well as radio programmes. World Environment Day Celebration was also a tool the EPA used to inform the public about environmental issues particularly climate change.

The District Assembly, World Vision Ghana, The Water Resources Commission and ORGIIS also organize periodic sensitization programmes on environmental awareness. For instance, the Water Resources Commission has erected a giant bill-board by the Anayeere's River along the Navrongo – Bolgatanga road to raised awareness about climate change. Despite these efforts aimed at creating awareness about climate change, much still needs to be done. At the area council level, knowledge about climate change was low. This was evident during the focus group discussions.

4.4.4 Alternative livelihoods

The EPA has pursued a number of alternative livelihood programmes aimed at facilitating adaptation to climate change in Kassena-Nankana West District. These include the training of women groups on alternative livelihoods ventures such as shea butter extraction, soap and pomade making among others. In addition, the EPA in conjunction with GEMP and CIDA runs a bee keeping project in Nakong (Plate 4.13) in the western part of the District. The bee keeping project is an alternative livelihood enhancing project aimed at controlling the menace of bush fires and the felling of trees for charcoal production.

Plate 4.13: The Nakong Bee Keeping Project



Source: Author's field survey, May 2014

The study found no alternative livelihood activities promoted by the Kassena-Nankana West District Assembly aimed at enhancing adaptation to climate change. Rather, other interventions relating to alternative livelihoods for climate change adaptation were pursued by ORGIIS and World Vision Ghana. The ORGIIS projects were on enterprise development through non-timber forest products such as the training of women in baobab seed oil extraction and provision of credit to women groups.

4.4.5 Improved Seed Varieties and Animal Breeds

Improved seed varieties and animal breeds were projects targeted at increasing the resilience of farmers against the impacts of climate change. According to the District Agricultural Development Unit (DADU), because of climate change, the local crop varieties and animal breeds were not doing well. For instance, because the local millet varieties (*naara* and *zea*) and *guinea corn* takes a longer time to mature and require much moisture to grow they are very sensitive to changes in rainfall. Therefore, there was the need to introduce early maturing and drought resistant varieties. In this regard, early maturing maize varieties such as *panar 53*, *pioneer* and *kapala dorke* were introduced. It was explained that the local millet and guinea corn varieties haven't been developed to the extent of maize varieties and that apart, the existing improved local varieties do not meet the taste of local farmers. It was noted that the improved maize varieties had superiority in terms of adaptation to local climatic conditions, higher yields and resistance to pest and diseases.

In the area of livestock, DADU was encouraging farmers to use improved breeds of sheep, goats and cattle from Burkina Faso and Niger. A guinea fowl breeding station was also established in the District the product of which include the fast growing and weightier Belgium breed of guinea fowl. Focus group discussion with councillors revealed that, farmers had little or no information about the availability of these improved varieties and breeds. Farmers therefore, had no access to these breeds and continue to use the local breeds and crop varieties. At Sirigu and Mirigu, the councillors indicated that no farmer within their area was sowing maize as a major crop because, it requires the use of fertilizer for which most of them could not afford. This implies that farmers have not adopted the improved maize varieties which suggest that the improved seeds were not well targeted and marketed well.

4.4.6 Integrated Soil and Land Management

Integrated soil and land management initiatives involve a series of measures aimed at controlling soil nutrient depletion and soil erosion. This involves land preparation change; no burning, minimum/zero tillage, contour ploughing-agronomic, chemical and physical changes, maintaining plant residue on the farm as well as the preparation and use of compost. Other measures include zero grazing for livestock through the harvesting of animal feed, creating community pastures, controlled grazing and discouraging the keeping of large

flocks. The integrated soil and land management projects were AfDB and World Bank pilot programmes on sustainable land and water management.

4.4.7 Natural Vegetation Management

The natural vegetation management include the *shrub pruning* (Plate 4.14 and Plate 4.15) described in Nakam and Kasem as *tintuori lebike tia* and *vokogo mo geri tio we nea* respectively. The initiative was promoted by World Vision Ghana and ORGIIS. It was run in two ways; agro-forestry (encouraging farmers to prune natural trees and use the residue as fuel wood instead of felling the trees and burning the residue) and protecting natural shrubs from bush fires and pruning them to grow into trees.

The idea behind the shrub pruning was that, as the climate changes, the vegetation also changes through the growth of more adaptable plant species. These species are however, burnt by bush fires or cut down for farming purposes. Therefore, allowing these tolerant species to grow naturally is an easy way to green and to improve the vegetation. The process is cheaper because it does not involve the buying of seedlings, planting cost, watering, fencing and other forms of maintenance.



Plate 4.14: A *tintuori lebike tia* on a farm in Sirigu.



Source: Author's field survey, May 2014

Plate 4.15: Sections of the *tintuori lebike tia* project at Navio



Source: Author's field survey, May 2014

The agro-forestry practices also involve the growing of *acacia albidia* trees on the farm. *Acacia albida* is a deciduous tree, and drops its leaves at the onset of the rainy-season. The leaves rapidly decompose to release nutrients at the time when young plants most need them. The tree remains leafless and does not cast enough shade to adversely affect crop grown beneath. The tree is grown naturally and the project only discourages farmers from felling them.

4.5 Mainstreaming climate change adaptation initiatives

4.5.1 Introduction

This section discusses the extent to which climate change adaptation is mainstreamed into development planning in the Kassena-Nankana West District. In particular, the section examines the institutional capacity level for mainstreaming climate change adaptation as well as the extent to which climate change adaptation issues are mainstreamed into development plans in the District.

4.5.2 Institutional Capacity for Mainstreaming Climate Change Adaptation

Effective mainstreaming depends to a large extent on the capacity of the institutions to understand the climate change situation and to identify appropriate areas of intervention (World Bank, 2012). Huq and Ayers, (2008) have identified enhancing institutional capacity as being crucial for effective mainstreaming of climate change adaptation into development policy and planning.

In the Kassena-Nankana West District, there were differential capacities at the district and sub-district levels. At the district level, staff that had training or attended workshops or conferences to enhance their capacities were the District Planning Officer and the Assistant District Planning Officer, the District Budget and Finance officers, the Director of MoFA and selected staff of NADMO. The rest of the staff of the assembly and the decentralized departments and agencies of the Assembly had no capacity building training relating to climate change.

Consequently, climate change adaptation issues were not captured in their plans and budgets. The understanding of the departmental heads/agencies that had no training on climate change was low. It should also be noted that institutional capacity for mainstreaming climate change

adaptation into development planning is not limited to capacity building training alone, but the building of institutional structures for handling climate change. Unlike other crosscutting issues like gender and disability that have been mainstreamed into the administrative and governance structure of the Assembly, institutional arrangement for mainstreaming climate change was lacking in the District. There was no climate change desk officer, neither at the Assembly nor the decentralized departments/agencies of the Assembly.

At the sub-district level, council members' opinion was that they had no training on climate change adaptation and none of them attended any workshop or conference on climate change. The study found that planning for climate change was lacking and even planning for development at this interface was largely ineffective. For instance, none of the seven area councils had prepared development plans for the 2010-2013 planning period. As a result, mainstreaming climate change adaptation was a challenge.

4.5.3 Mainstreaming climate change adaptation into District Development Plans

District development plans constitute the entry points for mainstreaming climate change adaptation. In Ghana, MMDAs prepare periodic Medium Term Development Plans (MTDP) as their development imperatives. The MTDPs also constitute the response of MMDAs to the development challenges in their areas. Kassena-Nankana West District prepared its first DMTDP in 2009 for the 2010-2013 planning period. As a requirement (from the National Medium Term Development Planning Framework -2010-2013), the District was to harmonize its development programmes, projects and activities around seven thematic areas; ensuring and sustaining macroeconomic stability enhancing competitiveness of Ghana's private sector, accelerated agriculture modernisation and sustainable natural resource management, oil and gas development, infrastructure and human settlements, human development, productivity and employment, and transparent and accountable governance. In addition, the National Medium Term Development Planning Framework (NMTDPF) required of the Assembly to mainstream cross-cutting issues such as climate change, gender and disability into its development plans and budgets.

Acting accordingly, the Assembly rolled-out 167 projects in its 2010-2013 DMTDP with an indicative budget of GH¢ 25,514,719.80. The study found in the DMTDP, that no direct climate

change adaptation projects were pursued in response to prevailing or anticipated climate change impacts or their effects. This notwithstanding, the study identified twenty one (21) projects relating to the environment. These projects were in the area of bush fire prevention, construction of boreholes, dams and dug-outs, tree planting, control of pest and diseases, and land, water and soil conservation.

In the view of ORGIIS, climate change issues were not captured in the DMTDP. It explained that, apart from some few environmental issues that were included in the DMTDP, there was no mentioning of climate change in the programmes and projects of the Municipality. ORGIIS tried to draw a distinction between climate change issues and environmental issues. It acknowledged that it was difficult to divorce climate change adaptation initiatives from initiatives targeting at improving the environment. However, ORGIIS noted that the distinction lies in the motive of their formulation. Thus, climate change adaptation initiatives are aimed at addressing specific climate change impacts as well as building resilience against certain forms of vulnerabilities. On the other hand, environmental initiatives are aimed at solving specific environmental challenges (e.g. desertification) which may not stem from climate change.

At the sub-district level, the study found that planning was ineffective. None of the seven area councils had prepared development plans for the 2010-2013 planning period. As a result, mainstreaming climate change was not possible at that level. However, the Assembly has supported tree planting at Mirigu, Kandiga, Kayoro, Buru-Navio area councils for which the communities were actively involved.

In the absence of effective vulnerability assessments and impact assessment, climate change adaptation initiatives may not be targeted and hence may not be effective. This was the case in Kassena-Nankana West District. Thus, mainstreaming of climate change adaptation into the district development plans still remains a challenge in the Kassena-Nankana West District. This supports the findings of Oates, Conway and Calow (2011) that the mainstreaming of climate change at the District level was yet at the elementary stages. Huq and Ayers, (2008) and the UNDP-UNEP, 2011 frameworks for mainstreaming have identified awareness raising and building of institutional capacities as the entry point for mainstreaming. However, in the

Kassena-Nankana West District, the strengthening institutional capacity for mainstreaming was yet to be achieved.

4.6 Challenges and Prospects for Mainstreaming Climate Change Adaptation for Sustainable Development

4.6.1 Introduction

This section discusses the challenges and prospects for mainstreaming climate change adaptation into development planning for sustainable development. The first part of the section discusses the challenges whilst the second part discusses the prospects for mainstreaming climate change adaptation in development planning in the Kassena-Nankana West District.

4.6.2 Challenges to the Mainstreaming of Climate Change Adaptation for Sustainable Development

The study identified a number of challenges militating against the mainstreaming of climate change adaptation into development planning in the Kassena-Nankana West District. These include limited information about the levels of vulnerability to climate change and climate change impacts, lack of early warning system, lack of institutional structures at the district and sub-district levels for dealing with climate change, neglect of local/traditional knowledge on adaptation, trivialization of climate change issues by decentralized departments and lack of statutory support for climate change.

Limited information about the levels of vulnerability to climate change impacts

Scientific information about the levels of vulnerability to climate change was virtually unavailable at both the study district and the region. At the district level, the Kassena-Nankana West District had not made any vulnerability assessment of the District to climate change. In the same vein, the NGOs that were interviewed also had no scientific information regarding climate change impacts and specific areas of vulnerability in the District. The EPA at the regional level also had no vulnerability assessment information regarding the District.

Effective planning is contingent on knowledge about the phenomenon one is planning for and in the case of climate change adaptation, a comprehensive risk assessment of current and future climate impacts as well as the vulnerability situation in the wake of threatening climatic impacts

is key to facilitating adaptation and enhancing resilience. The absence of these measures makes planning for climate change reactionary (Easterling, Hurd and Smith, 2004; UNFCCC, 2006; TERI, 2006; IPCC, 2007).

Lack of early warning system and disaster risk management schemes

Relaying relevant information about potential changes in the weather is crucial for adaptation to climate change. Therefore, planning for climate change adaptation should among other things include generating accurate and reliable information about the weather, monitoring specific climate change stressors and their effects and transmitting information to farmers and households to engender the appropriate responses. According to the District Agriculture Development Unit (DADU) of the Kassena-Nankana West District, early warning system for farmers was not available at the district level. This leaves farmers helpless to dry spells and floods. For instance, at time of the study, the first rains for the season had started. Though the rains were heavy, farmers were confused as to whether to sow or not to sow their crops. In the face of uncertainties about the weather, farmers need information about the likely distribution of rainfall and the likely occurrence of climate extremes to act appropriately to avoid harm. NADMO have argued that they relay some information about potential floods to the districts. The area councils affirmed this and added that, the information is usually passed on as an announcement about the opening of the Bagre Dam in Burkina Faso.

Lack of institutional structures at the district and sub-district levels for dealing with climate change

In order to advance the mainstreaming of climate change adaptation into local development plans, there is the need to set up institutional structures. Climate change has been identified in the NMTDPF along with other cross-cutting issues like gender and disability for mainstreaming into District Medium Term Development Plans (DMTDP). Yet unlike disability and gender, climate change has not been mainstreamed into the administrative structure of the assembly. This makes planning for climate change difficult. DADU and ORGIIS have argued that for mainstreaming to be effective, atleast, there should be a climate change desk officer at the assembly to advocate, facilitate and coordinate climate change projects within the District.

Neglect of local/indigenous knowledge on climate change adaptation

Local or indigenous knowledge is also crucial for enhancing adaptation to climate change. As observed by Easterling, Hurd and Smith (2004) adaptation to climate change is a fundamental human attribute hence man has since pre-historic times adopted different strategies in response to daunting environmental challenges. Therefore, the mainstreaming process should incorporate the knowledge and experiences of people and facilitate appropriate responses to climate change. The study found that ORGIIS and World Vision Ghana have made significant successes in promoting environmental sustainability through the promotion of the *tintuori lebigi tia* project which relies on the use of indigenous knowledge. Therefore, the Assembly's success in the fight against climate change and environmental degradation will largely depend on its ability to integrate indigenous knowledge with modern techniques and approaches.

Trivialization of climate change issues by decentralized departments

It was observed during the interviews with the decentralized departments that, climate change adaptation was not being taken seriously. With the exception of DADU, none of the decentralized departments or agencies has pursued any programme relating to climate change. That apart their attitude towards climate change was that, climate change was an environmental issue and had nothing to do with them. For instance, the District Director of Ghana Health Services retorted, *'we are not involved in climate change. It does not concern us much. All I know is that, there is a pilot project on climate change and Bongo District was chosen in Upper East Region. May be you should have gone to Bongo. You can also contact MoFA, may be they can help you.'* The story was not different at Ghana Education Service, Environmental Sanitation Unit and Town and Country Planning Department. This trivialization of climate change issues by the decentralized departments pose a challenge to effective mainstreaming at all levels of the Assembly.

Lack of statutory support for climate change adaptation

It was observed that, statutory support for climate change adaptation at the district level was lacking. There was no special fund set aside for financing climate change adaptation programmes and the Assembly was not required by law to spend a certain percentage of its funds on climate change. This leaves the mainstreaming of climate change at the mercy of policy makers and

planners who decide whether or not to include climate change issues and if they should, the kind of issues from their discretion that should be included. DADU and ORGIIS have argued that unless there is a statutory support for climate change adaptation, the trivialization of climate change will continue. The opinion of DADU was that since climate change was a cross-cutting issue which poses a challenge to sustainable development, it would be given attention if by statutory requirement, the District was to spend about 5 percent of its revenue on climate change adaptation issues. The priority of the assembly, it was alleged, was on tangible projects like schools, hospitals, roads that they could hold ceremonies to commission and campaign for votes.

4.6.3 Prospects for Mainstreaming Climate Change Adaptation into Development Planning

Despite the challenges discussed in section 4.6.2, the prospects for mainstreaming climate change into Development planning in Kassena-Nankana West District still remain high. These include; capacity building for District Assembly staff and heads of decentralized departments/agencies, the use of both scientific and indigenous knowledge systems on climate change adaptation, institutionalizing climate change adaptation within the administrative and governance structure of the Assembly, building the capacity of area councils to plan for climate change at the community level and *ex ante* environmental assessments of programmes and projects.

Building the Capacity of District Assembly Staff and Heads of Decentralized Departments/Agencies

The mainstreaming of climate change adaptation into development planning will depend on knowledge of planners and policy makers. Therefore, there is the need to train and sensitize local planners and policy makers on the nature of the climate change situation in their area and how to integrated key issues pertaining to climate change into local plans and programmes.

The use of both scientific and indigenous knowledge systems on climate change adaptation

The study found that scientific knowledge on climate change was virtually absent and indigenous knowledge was ignored. Therefore, for mainstreaming to be effective, there is the need to conduct disaster risk assessments which will lead to the formulation and implementation of

disaster risk reduction programmes. These assessments should incorporate both scientific and indigenous knowledge.

Institutionalization of climate change adaptation within the district level administrative and governance structures

It was also observed that the institutionalization of climate change adaptation within the governance and administrative structures is one avenue for making the mainstreaming of climate change adaptation work at the district level. Respondents proposed that, there should be a climate change desk officer at the assembly to coordinate all climate change adaptation initiatives in the district. The respondents noted that, the mainstreaming of gender and disability have achieved some successes because of their institutionalization within the governance system.

Building the capacity of area councils to plan for climate change at the community level

It was observed that climate change is a local (community) problem and perhaps, is best tackled at that level. Therefore, the mainstreaming of climate change adaptation in the District should start with the area councils. Hence the area councils were weak and inactive, building their capacities is essential for effective mainstreaming.

Environmental assessments of programmes and projects

The NDPC requires all development plans to be subjected to Strategic Environmental Assessment (SEA). SEA can be streamlined and used as a tool for climate change mitigation and adaptation.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter presents a summary of key findings of the study, draws a conclusion based on the findings and finally offers recommendations on how climate change adaptation can be mainstreamed into development planning for climate proofing and resilience.

5.2 Summary of Findings

5.2.1 Perspectives on Climate Change in Kassena-Nankana West District

There were differing perspectives on climate change among respondents. Precipitated by low knowledge on climate change, climate change adaptation was viewed by majority of the heads of decentralized departments as an environmental issue that was tangential to their operations. At the community level, respondents understood climate change from their experiences and observations about the elements of the weather particularly, temperature and rainfall. Judging from their childhood days, they noted significant changes in temperature and rainfall and their effects on lives and livelihoods.

5.2.2 Vulnerability and Climate Change Adaptation in the Kassena-Nankana West District

Using the IPCC's components of vulnerability, the study sought to determine the vulnerability situation in Kassena-Nankana West District. In terms of exposure to climate change, the study found that, the District was exposed to droughts/dry spells, high temperatures, windstorms and heavy rains/floods. Even though, these climatic extremes and hazards were historically not new to the area, respondents said the ubiquity and intensity of their occurrences have increased over the last few years.

The study also found that sensitivity to climate change was high. Agriculture, water resources and social infrastructure were the most sensitive sectors of the District. Crop production in the District has declined considerably due to low yields resulting from droughts/dry spells, high temperatures, heavy rainfall and floods. For instance, the production of millet and sorghum in 2006 was 10,100 and 19,785 respectively. These declined to 1,040 and 1,450 respectively in

2012. The study found that because crop production was becoming increasingly unproductive, most households were investing in livestock farming as an alternative means of livelihood. As a result, the production of livestock has increased from 506, 004 units in 2006 to 642,545 in 2012. It was also observed that there was scarcity of pasture for animals especially in the eastern part of the District. This was due in part to the occurrence of a dry spell that often hit the area.

Water resources in the District were also heavily affected by climate change related hazards/stressors, directly and indirectly. The Atankwide and Anayere's rivers that used to contain water all year round were dried up. This was partly blamed on dry season farming involving the digging of trenches in the bed of the river for water for irrigation. There was also evidence of siltation which reduced the rivers to mere streams. Also, underground water levels were also purported to have decreased, thus affecting the functioning of boreholes.

Similarly social infrastructure such as roads and houses were negatively affected by climate change. Local houses which are build with mud and roofed with iron sheets or grasses or mud and wood were particularly sensitive to heavy rains/floods and windstorms. Data from Ghana Education Service indicate over seven (7) school building were destroyed by windstorms from 2010 to 2014. In addition, flood waters also washed away culverts and portions of feeder roads.

Despite the high exposure and sensitivity to climate change, the study found that the ability of the District to adapt to climate change extremes was rather weak. Using fourteen (14) indicators adapted from Dazé, Ambrose and Ehrhart (2009), the study found that the needed human, socio-political, physical, natural and financial resources for facilitating adaptation to climate change in the District was lacking.

5.2.3 Climate Change Adaptation Initiatives in Kassena-Nankana West District

The study identified a number of initiatives relating to climate change adaptation that were pursued by communities, NGOs and the District Assembly. These initiatives include integrated water resources management practices, integrated soil and land management, promotion of alternative livelihoods, improved seed varieties and animal breeds, education and awareness creation, and natural vegetation management. The initiatives were not based on the analysis of

existing vulnerabilities, climate and disaster risk assessment. Therefore, they could be classified as reactive responses to climate change.

5.2.4 Mainstreaming climate change adaptation initiatives in Kassena-Nankana West District

Enhancing institutional capacity is crucial for effective mainstreaming of climate change. This notwithstanding, the capacity of decentralized institutions was considered weak as they have not had capacity building programmes on climate change adaptation. Consequently, there was a lack of awareness about climate change among decentralized departments and agencies with the exception of DADU and NADMO. The lack of knowledge about climate change affected planning for climate change as no climate change adaptation issues were pursued by the decentralized departments. Capacity for climate change mainstreaming at the sub-district level was also considered weak.

Initiatives relating to climate change that were captured in the DMTDP, of Kassena-Nankana West District were bush fire prevention, construction of boreholes, dams and dug-outs, tree planting, control of crop pest and diseases, and land, water and soil conservation. These initiatives were at best described as environmental initiatives. The motive of their implementation was to respond to prevailing environmental problems rather than specific climate change hazards and stressors. This was evidenced by the absence of climate change and disaster risk information regarding the potential impacts.

At the sub-district level, there was no evidence of planning for climate change adaptation. Thus, mainstreaming of climate change adaptation into the district development plans still remains a challenge in the Kassena-Nankana West District.

5.2.5 Challenges and Prospects for Mainstreaming Climate Change Adaptation for Sustainable Development

The study identified some challenges that affect the effective mainstreaming of climate change adaptation into development planning in the Kassena-Nankana West District. It was observed that there was limited information about the levels of vulnerability to climate change and climate change impacts. Similarly, early warning systems for farmers and households were lacking. For

instance, farmers had no access to information about potential drought/dry spells and were therefore at the mercy of the weather. Also, climate change adaptation was not mainstreamed into the institutional structures at the district and sub-district levels. This made advocacy for and the coordination of climate change adaptation in the District difficult. There was also the concern that indigenous knowledge has been neglected in the fight against climate change adaptation in the District. Evidence from ORGIIS and World Vision Ghana shows that indigenous knowledge is useful in promoting climate resilience. Other challenges to the mainstreaming efforts in the District were the trivialization of climate change issues by decentralized departments and lack of statutory support for climate change.

Despite the above challenges, the prospects for mainstreaming climate change adaptation in the Kassena-Nankana West District are still bright. The integration of scientific knowledge with indigenous knowledge represents a prospect for mainstreaming climate change adaptation in the District. Similarly, the capacities of decentralized and sub-district institutions if enhanced would constitute a great potential for mainstreaming climate change adaptation into development planning. For the mainstreaming process to be effective, then climate change will have to be institutionalized. This will promote the coordination of climate change programmes. Finally, the *ex-ante* environmental assessments of development programmes and projects of the District Medium Term Development Plan offers an opportunity for mainstreaming climate change adaptation into the development plans of the District.

5.3 Conclusion

Even though, climate change has been mainstreamed in the GSGDA under the thematic area of accelerated agriculture modernisation and sustainable natural resource management and also, as one of the key cross-cutting issues, mainstreaming at the District level still remains a challenge. Albeit, vulnerability to climate change is high in the Kassena-Nankana West District, adaptive capacity was low. Initiatives in the District were in response to environmental challenges rather than climate change impacts. As a result, the District's approach to fighting climate change was reactive or autonomous. Mainstreaming have not been effective both at the district and sub-district levels.

A number of challenges accounted for the poor mainstreaming of climate change in Kassena-Nankana West District. These include limited knowledge on climate change risks and disaster preparedness, the neglect of indigenous knowledge, lack of institutional capacity among others. Despite the challenges, the prospects for mainstreaming climate change adaptation into development planning in the District still remains high. Some of these prospects include the wealth of unexploited indigenous knowledge on climate change adaptation and the non-institutionalization of climate change in the District.

5.4 Recommendation

5.4.1 Introduction

Mainstreaming of climate change adaptation into district development plans remains a viable strategy for tackling the climate change menace to promote sustainable development. However, as evidenced from this study, a lot more work needs to be done for mainstreaming to be successful. This will include building the capacity of district assembly staff, and heads of decentralized departments, the institutionalization of climate change, statutory support for climate change adaptation, integrating indigenous knowledge with modern scientific knowledge, establishment of early warning system and disaster risk preparedness as well as encouraging community participation in climate change adaptation programmes

5.4.2 Building the Capacity of District Assembly Staff and Heads of Decentralized Departments/agencies

The mainstreaming of climate change adaptation into development planning will depend on capacity of staff of the District Assembly and the decentralized departments and agencies. As noted by Huq and Ayers, (2008) the mainstreaming process starts with awareness raising and the building of capacities. In this regard, the study recommend that the government through the EPA should organize capacity building workshops on climate change adaptation for District Assembly staff and heads of decentralized departments/agencies in order to enhance their capacity to mainstream climate change adaptation into development plans.

5.4.3 Institutionalization of climate change

Institutional arrangement for the mainstreaming of climate change at the district and sub-district levels in Kassena-Nankana West District was non-existent. It was observed that, mainstreaming cannot take place in an institutional vacuum. As a result, mainstreaming should involve the institutionalization of climate change adaptation within the administrative and governance structure of the District. The study therefore recommends that as part of the institutionalization of climate change adaptation at the district level, the governance acting through the Ministry of Local Government and Rural Development, should establish a climate change desk office within the District Assembly. This climate change desk officers should have oversight responsibilities for the mainstreaming of climate change adaptation across all levels of the Assembly.

5.4.4 Statutory support for climate change adaptation

Albeit climate change has been included in national development policy at the national level in Ghana, the lack of statutory support for implementation at the sub-national level is a challenge for mainstreaming climate change adaptation at the district level. The study recommends that there should be statutory support for the mainstreaming of climate change adaptation. This should include using legislation to compel MMDAs to use a certain proportion of their revenues to finance climate change adaptation initiatives.

5.4.5 Integrating Indigenous Knowledge with Modern Scientific Knowledge

Ignoring local knowledge on adaptation has been proven to be unhelpful. For the mainstreaming process to be successful, scientific knowledge and local knowledge should not be considered as separate entities but rather complementary. The study therefore, recommends that, MMDAs should combine local or indigenous knowledge systems with scientific knowledge for effective adaptation.

5.4.6 Establishing Early Warning Systems and Disaster Risk Preparedness

One key finding of the study is the lack of early warning systems and disaster risk preparedness plans at the district level. This situation weakened the adaptive capacity of the District. Therefore, for mainstreaming to be effective, it has to be grounded on reliable information about the climate phenomenon as well as the continuous assessment of climate risks, vulnerabilities

and relaying relevant information for local level adaptation. The study therefore recommends that the district should establish early warning systems and make information regarding specific climate change risks or disasters accessible in the district.

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APPENDICES

APPENDIX A. INTERVIEW GUIDES

Interview Guide for District Assembly Staff (DBO, DPO, DCD, DFO & TCPD)

Date of Interview:

Contact number

Section A: Perspectives about climate change

1. Have you attended any programme on climate change?
 - a) If yes, how many programmes have you attended within the last four (4) years?
 - b) Kindly state what you learnt from the programme(s)

2. What is your understanding of climate change?

Section B: Vulnerability to Climate Change

3. What climate change related hazards do you experience in your district?

4. Describe the impact of climate change on the following in your district;

- a) Agriculture

- b) Water resources

- c) Human health and security

- d) Social Infrastructure

- e) The environment

5. The following table provides a framework for analyzing the adaptive capacity of your district. Complete it appropriately.

Type of Resource	Components	Situation in Study Area	Spatial Dimension	Remarks
Human	Knowledge of climate risks			
	Technology			
	Good health for labour			
Social	Women's savings and loans groups			
	Farmer-based organizations			
	Stable and effective institutions			
Physical	Irrigation infrastructure, seed and grain storage facilities			
	Agriculture information centers			
Natural	Reliable water source			
	Productive land			
Financial	Micro-insurance			
	Diversified income sources			
Political Capital	Policies and plans (DMTDP),			
	Institutions and power structures			

6. How will you describe the climate change vulnerability situation in the District?

.....

Section B: Adaptation Initiatives

7. Has there been an assessment of climate change vulnerability and disaster risk in the District?
- a) If yes, briefly state the findings, outputs and outcomes (*request for documents if available*)

.....

- b) If no, explain why?

8. Is the district having a disaster risk reduction strategy?
 a) If yes, describe the nature of the strategy. (*request for documents*)

9. What specific adaptation programmes and projects have been pursued by the assembly over the past four (4) years?

10. What specific programmes and projects have been pursued by organizations other than the Assembly?

Organization	Area of Focus/Field	Adaptation initiatives	Duration of programmes
1.			
2.			

11. Were the initiatives facilitated or coordinated by the assembly? If yes, explain

12. Does the district allocate funds for dealing with climate change hazards as and when they occur? Please give examples.

Section C. Mainstreaming of Adaptation Initiatives

13. Do you include climate change issues in the District Medium Term Development Plan (DMTDP)? What climate change initiatives have been captured in the district development plans?
 a) If yes, give examples (*request for copy of DMTDP 2010-2014 for triangulation*)

- b) If no, give reasons why?

14. Describe the funding arrangements for the initiatives

15. What percentage of the initiatives was fully implemented? Explain why?

16. Have the initiatives had any effect on the level of vulnerability in the District?

.....
.....
.....
17. What are the challenges and prospects for mainstreaming climate change into development planning in the district?

a) What has worked well so far?

b) Explain why things worked well?

c) What has not worked well so far?

d) Explain why things did not work well?

e) What need to be done?

Interview Guide for Heads of Decentralised Departments/Agencies
(DADU, GHS, GES, ESU, Forestry Commission)

Date of Interview: Contact number

Section A: Perspectives about climate change

1. Have you attended any programme on climate change?

a) If yes, how many programmes have you attended within the last four (4) years?

b) Kindly state what you learnt from the programme(s)

2. What is your understanding about climate change?

Section B: Vulnerability to Climate Change

3. What climate change related hazards do you experience in your district?

4. Describe the impact of climate change on the following in your district;

a) Agriculture

b) Water resources

c) Human health and security

.....

.....

d) Social Infrastructure

.....

.....

e) The environment

.....

.....

5. The following table provides a framework for analyzing the adaptive capacity of your district. Complete it appropriately.

Type of Resource	Components	Situation in Study Area	Spatial Dimension	Remarks
Human	Knowledge of climate risks			
	Technology			
	Good health for labour			
Social	Women's savings and loans groups			
	Farmer-based organizations			
	Stable and effective institutions			
Physical	Irrigation infrastructure, seed and grain storage facilities			
	Agriculture information centers			
Natural	Reliable water source			
	Productive land			
Financial	Micro-insurance			
	Diversified income sources			
Political Capital	Policies and plans (DMTDP),			
	Institutions and power structures			

6. How will you describe the climate change vulnerability situation in the District?

.....

.....

Section B: Adaptation Initiatives

7. Has there been an assessment of climate change vulnerability and disaster risk involving your department/agency?
- a) If yes, briefly state the findings, outputs and outcomes (*request for documents if available*)
-
- b) If no, explain why?
-
8. Is your department/agency having a disaster risk reduction strategy?
9. If yes, describe the nature of the strategy. (*request for documents*)
-
10. What specific climate change adaptation programmes and projects have your department/agency pursued over the past four (4) years?
-
11. What specific programmes and projects have been pursued by organizations other than your department/agency?

Organization	Area of Focus/Field	Adaptation initiatives	Duration of programmes
1.			
2.			

12. Were the above initiatives facilitated or coordinated by the assembly or your department/agency? If yes, explain
-
13. Does your department/agency allocate funds for dealing with climate change hazards as and when they occur? Please give examples.
-

Section C. Mainstreaming of Adaptation Initiatives

14. Do you include climate change issues in your plans?
- a) If yes, give examples (*request for copy of DMTDP 2010-2014 for triangulation*)
-
- b) If no, give reasons why?
-
15. Describe the funding arrangements for the initiatives in mention in 17a)

.....
.....
16. What percentage of the initiatives was fully implemented? Explain why?
.....
.....

17. Has the initiatives had any effect on the level of vulnerability in the District?
.....
.....

18. What are the challenges and prospects for mainstreaming climate change adaptation into development planning in the district?

a) What has worked well so far?
.....
.....

b) Explain why things worked well?
.....
.....

c) What has not worked well so far?
.....
.....

d) Explain why things did not work well?
.....
.....

e) What needs to be done?
.....
.....

Interview Guide for NADMO, Water Resources Commission and EPA

Date of Interview: Contact number

Section A: Perspectives about climate change

1. Have you attended any programme on climate change?

2. If yes, how many programmes have you attended within the last four (4) years?

3. Kindly state what you learnt from the programme(s)
.....
.....

4. What is your opinion about climate change?
.....
.....

Section B: Vulnerability to Climate Change

5. What climate change related hazards do you experience in the region/district?
.....
.....

6. Describe the impact of climate change on the following in the region/district;

a) Agriculture

.....

 b) Water resources

c) Human health and security

d) Social Infrastructure

e) The environment

7. The following table provides a framework for analyzing the adaptive capacity of the region/district. Complete it appropriately.

Type of Resource	Components	Situation in Study Area	Spatial Dimension	Remarks
Human	Knowledge of climate risks			
	Technology			
	Good health for labour			
Social	Women's savings and loans groups			
	Farmer-based organizations			
	Stable and effective institutions			
Physical	Irrigation infrastructure, seed and grain storage facilities			
	Agriculture information centers			
Natural	Reliable water source			
	Productive land			
Financial	Micro-insurance			
	Diversified income sources			
Political Capital	Policies and plans (DMTDP),			
	Institutions and power structures			

8. How will you describe the climate change vulnerability situation in the region/district?

.....
.....

Section B: Adaptation Initiatives

9. Has there been an assessment of climate change vulnerability and disaster risk in the region/district?

10. If yes, briefly state the findings, outputs and outcomes (*request for documents if available*)

.....
.....

If no, explain why?

.....

11. Is the region/district having a disaster risk reduction strategy?

12. If yes, describe the nature of the strategy. (*request for documents*)

.....
.....

What specific climate change adaptation programmes and projects have your organization/agency pursued over the past four (4) years?

.....
.....

What specific programmes and projects have been pursued by organizations other than your department/agency in the Kassena-Nankana West District?

Organization	Area of Focus/Field	Adaptation initiatives	Duration of programmes
1.			
2.			

13. Were the above initiatives facilitated or coordinated by the Kassena-Nankana West District Assembly or your organization/agency? If yes, explain

.....
.....

14. Does your organization/agency allocate funds for dealing with climate change hazards as and when they occur? Please give examples.

.....
.....

Section C. Mainstreaming of Adaptation Initiatives

15. Do you include climate change issues in your plans?

c) If yes, give examples (*request for copy of DMTDP 2010-2014*)

.....
.....

d) If no, give reasons why?

-
-
16. Describe the funding arrangements for the initiatives in mention in 17a)
-
-
17. What percentage of the initiatives was fully implemented? Explain why?
-
-
18. Has the initiatives had any effect on the level of vulnerability in the region/district?
-
-
19. What are the challenges and prospects for mainstreaming climate change adaptation into development planning in the region/district?
- f) What has worked well so far?
-
-
- g) Explain why things worked well?
-
-
- h) What has not worked well so far?
-
-
- i) Explain why things did not work well?
-
-
- j) What need to be done?
-
-

Checklist for FGDs with Area Councils

Name of Area Council:

Contact Person..... Contact number

Number of Participants: Date of Interview:

Section A: Perspectives about climate change

1. Have you attended any programme on climate change?
2. If yes, how many programmes have you attended within the last four (4) years?
3. Kindly state what you learnt from the programme(s)
4. What is your opinion about climate change?

Section B: Vulnerability to Climate Change

5. What climate change related hazards do you experience in your area?
6. Describe the impact of climate change on the following in your area;
 - a) Agriculture
 - b) Water resources
 - c) Human health and security

d) Social Infrastructure

7. The environment the following table provides a framework for analyzing the adaptive capacity of your area/district. Complete it appropriately.

Type of Resource	Components	Situation in Study Area	Spatial Dimension	Remarks
Human	Knowledge of climate risks			
	Technology			
	Good health for labour			
Social	Women's savings and loans groups			
	Farmer-based organizations			
	Stable and effective institutions			
Physical	Irrigation infrastructure, seed and grain storage facilities			
	Agriculture information centers			
Natural	Reliable water source			
	Productive land			
Financial	Micro-insurance			
	Diversified income sources			
Political Capital	Policies and plans (DMTDP),			
	Institutions and power structures			

8. How will you describe the climate change vulnerability situation in the District?

Section B: Adaptation Initiatives

9. Has there been an assessment of climate change vulnerability and disaster risk involving your department/agency?
10. If yes, briefly state the findings, outputs and outcomes (*request for documents if available*)

If no, explain why? Is your department/agency having a disaster risk reduction strategy?

11. If yes, describe the nature of the strategy. (*request for documents*)

.....

 What specific climate change adaptation programmes and projects have your department/agency pursued over the past four (4) years?

.....

 What specific programmes and projects have been pursued by organizations other than your department/agency?

Organization	Area of Focus/Field	Adaptation initiatives	Duration of programmes
1.			
2.			

12. Were the above initiatives facilitated or coordinated by the assembly or your department/agency? If yes, explain

13. Does your department/agency allocate funds for dealing with climate change hazards as and when they occur? Please give examples.

Section C. Mainstreaming of Adaptation Initiatives

14. Do you include climate change issues in your plans?

e) If yes, give examples (request for copy of DMTDP 2010-2014 for triangulation)

f) If no, give reasons why?

15. Describe the funding arrangements for the initiatives in mention in 17a)

16. What percentage of the initiatives was fully implemented? Explain why?

17. Has the initiatives had any effect on the level of vulnerability in the District?

18. What are the challenges and prospects for mainstreaming climate change adaptation into development planning in the district?

k) What has worked well so far?

l) Explain why things worked well?

m) What has not worked well so far?

n) Explain why things did not work well?

o) What need to be done?

Interview Guide for NGOs (World Vision & ORGIIS)

Date of Interview:

Contact number

-
1. How long have you been operating in this district?
 2. What is the focus of your work in the district?
 3. From your experience, and observations, what are the main development problems of the district?
 4. To what extent do you think climate change is a problem in the district?
 5. What climate change related hazards do you experience in the district?
 6. What are the impacts of climate change in relation to the following in the district?
 - a) Agriculture
 - b) Water resources
 - c) Human health and security
 - d) Infrastructure
 - e) Poverty
 - f) The environment
 - g) Non-farm economic activities
 - h) Others (Specify)
 7. How are people coping with these impacts in the district?
 8. Are people receiving assistance to help them cope and adapt to the impacts? Explain.
 9. What interventions have your organisation pursued or intent to pursue in relation to climate change adaptation?
 10. How are you collaborating with the District Assembly in relation to climate change?
 11. How will you describe the Assembly's approach to fighting climate change?

12. Do you think climate change adaptation has been adequately mainstreamed into development plans/budgets in the district?
13. In your opinion, what needs to be done to mainstreamed climate change adaptation into development plans and budgets in the Assembly?

KNUST



APPENDIX B. Extract from The World Bank Group (2011) on changes in the climate of Ghana

Climate Risk and Adaptation Country Profile	Ghana
<p>The major rainfall and temperatures patterns form the basis of the agro-climatic zones—namely, the Sudan Savanna zone, the Guinea Savanna zone, the Transition Zone, the semi-Deciduous Rainforest zone, and the High Rainforest Zone. Each zone is represented geo-climatically by Navrongo, Tamale, Wenchi, Kumasi, and Axim, respectively.⁶</p> <p>The climate baseline trends for Ghana (since 1960) can be summarized as follows:⁷</p> <ul style="list-style-type: none"> ➔ Mean annual temperature has increased by 1.0°C, at an average rate of 0.21°C per decade. The rate of increase has been higher in the northern regions of the country than in the south. ➔ The average number of 'hot' days⁸ per year increased by 48 between 1960 and 2003. ➔ The average number of 'hot' nights per year increased by 73 in the same period. ➔ The average number of 'cold' days⁹ per year decreased by 12 (3.3% of days) between 1960 and 2003. ➔ The average number of 'cold' nights per year decreased by 18.5 (5.1% of days) in the same period. ➔ Annual rainfall in Ghana is highly variable on inter-annual and inter-decadal timescales and long-term trends are difficult to identify. ➔ Rainfall over Ghana was particularly high in the 1960s, and decreased to particularly low levels in the late 1970s and early 1980s, producing an overall decreasing trend in the period 1960 to 2006, with an average precipitation of 2.3 mm per month (2.4%) per decade. ➔ There is no evidence of a trend in the proportion of rainfall that has occurred in 'heavy'¹⁰ events since 1960. 	
CLIMATE FUTURE	
<p>Generally, climate models cannot project changes in regionally driven climate phenomena, such as ENSO. Thus, for Ghana climate models show a wide range of projected changes in the amplitude of future El Niño type of events. As the climate in Ghana is strongly influenced by ENSO, this contributes to uncertainty in climate projections. Projections of precipitation changes for the Sahelian and Guinea coast regions of Africa are strongly divergent and most models fail to reproduce realistic inter-annual and inter-decadal rainfall variability in the Sahel in 20th century simulations. This adds to the uncertainty in the projected changes.</p>	
<p>Several studies have been undertaken to reveal overall climate trends for Ghana in the future. These include the World Bank study of the Economics of Adaptation to Climate Change Study (looking at the 2010-2050 period) and the 2000 UNDP Climate Profile of Ghana (looking at the 2060-2090 period). Among their findings are the following:</p>	
<ul style="list-style-type: none"> ➔ The mean annual temperature is projected to increase by 1.0 to 3.0°C by the 2060s, and 1.5 to 5.2°C by the 2090s. The projected rate of warming is most rapid in the northern inland regions of Ghana. ➔ Under the Ghana Dry climate scenario, temperatures in the three regions of the North are projected to increase by 2.1–2.4°C, in the western, western-central, and Volta regions by 1.7–2.0°C, and in the Brong Ahafo region by 1.3–1.6°C. ➔ All projections indicate substantial increases in the frequency of days and nights that are considered 'hot' in current climate, but the range of projections between different models is large. ➔ Total annual rainfall is projected to decline by 1.1%, and 20.5% in 2020 and 2080, respectively. ➔ Seasonality is projected to change, with early termination of rainfall in the transitional zone, and is likely to convert the current bi-modal regime to a uni-modal one. 	
<p>⁶ Ghana National Communication to the United Nations Framework for Climate Change.</p> <p>⁷ IPCC 4th Assessment Report and UNDP Climate Profiles.</p> <p>⁸ 'Hot' days or nights are defined as the temperature above which 10% of days or nights are recorded in current climate of that region/season.</p> <p>⁹ 'Cold' days or night are defined as the temperature below which 10% of days or nights are recorded in current climate of that region/season.</p> <p>¹⁰ A 'heavy' event is defined as a daily rainfall total that exceeds the threshold above which 5% of rainy days in the current climate have been recorded for that region and season.</p> <p style="text-align: center;">4</p>	

- ➔ The projections for precipitation indicate a cyclical pattern over the period 2010–2050 for all regions, with high rainfall levels followed by a drought every decade or so. The wettest parts of the country are expected to be the Tropical and Moist Deciduous Rainforest zone (in the Ashanti and Western regions) and Coastal zone (Volta, Eastern, Central, and Greater Accra regions). The northern and southern Savannah zones are projected to be relatively dry.
- ➔ The proportion of total annual rainfall that falls in 'heavy' events tends toward increases and there is a trend in the projections toward a decrease in January–June rainfall (dry season), and increases in July–August rainfall (wet season), suggesting that the wet seasons are projected to get wetter and the dry seasons drier.
- ➔ Projected changes in 1- and 5-day rainfall maxima tend toward increases, but projections vary a great deal.
- ➔ Sea level rise is projected at 5.8 cm, 16.5 cm and 34.5 cm by 2020, 2050, and 2080, respectively.

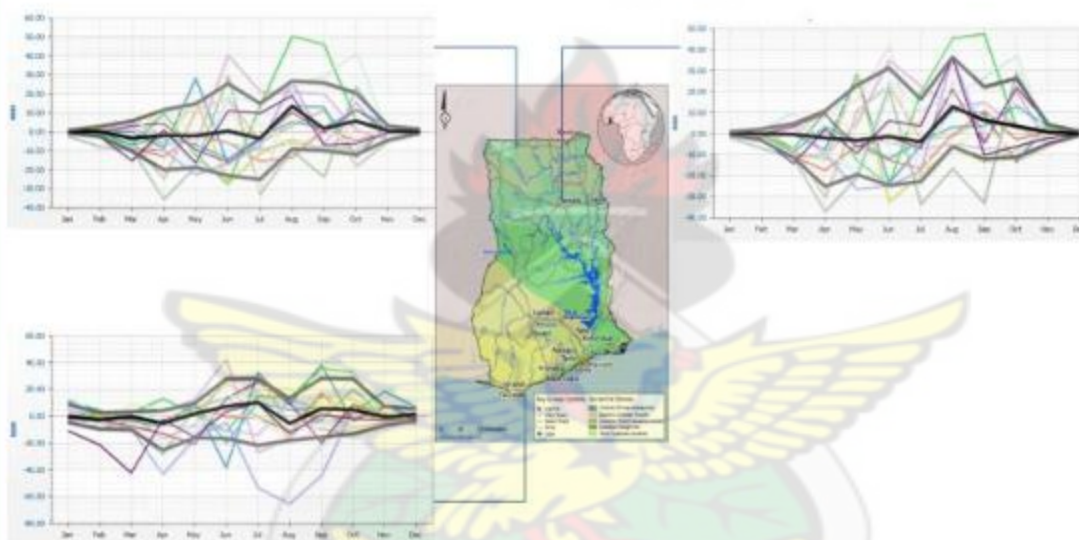


Figure 2: Projected changes in rainfall for 2020–2039 as compared to between 1970–1990¹¹
(Note the wide disagreement across models, particularly from October to April.)

Overall, Ghana is projected to become hotter and wetter during the wet season and drier during the dry season, with increased sea level rise and storm surges.

CLIMATE CHANGE IMPACTS ON NATURAL HAZARD VULNERABILITY

- ➔ **Floods and landslides**- Ghana is exposed to floods, particularly in the northern Savannah belt, and faces associated risks of landslides. Extreme rainfall events have increased over the 1986–1995 period, including a high number of 24-hour maximum rainfall events—a trend that has continued in the last decade. The parallel increases in temperature across all river basins suggest that the observed intensification in flood

¹¹ The World Bank's Climate Change Knowledge Portal, Data from IPCC CMIP3 Archive.