

**UNIVERSITY OF GHANA**



**THE ROLE OF INSTITUTIONAL SUPPORT IN CLIMATE CHANGE  
ADAPTATION AMONGST SMALLHOLDER FARMERS IN THE SISSALA  
EAST AND WEST DISTRICTS OF GHANA**



**A THESIS PRESENTED TO THE SCHOOL OF SOCIAL SCIENCES AND THE  
UNIVERSITY OF GHANA IN PARTIAL FULFILMENT OF THE  
REQUIREMENT FOR THE AWARD OF MASTER OF PHILOSOPHY DEGREE  
(CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT)**

**DECEMBER 2014**

## DECLARATION

I hereby declare with all academic honesty that, this work is my original work. It has not been reproduced or presented anywhere either in part or in whole. I acknowledge using and citing works from other sources and authors. I am solely to be held responsible for any errors in this work.

.....

RUTH QUAYE

(CANDIDATE)

DATE.....



### CERTIFICATION

We hereby declare that this thesis was supervised in accordance with the guidelines laid down by the University of Ghana, Legon.

Principal Supervisor’s Signature ..... Date.....

(DR. KWADWO OWUSU)

Co-Supervisor’s Signature..... Date.....

(DR. THOMAS BUABENG)



## ACKNOWLEDGEMENT

All thanks to Jehovah for seeing me through another stage of the educational ladder. It has not been all rosy but His grace and mercy has seen me through. Appreciation goes to all who made it possible for this dream to come true.

I say a special thanks to my parents and siblings for their faith, encouragement and support throughout these years – may God bless you. I will also like to thank the B4C/OSF for the scholarship offered me. I will forever be indebted to my supervisors Dr Kwadwo Owusu and Dr Thomas Buabeng for their patience and magnanimous contributions to this work. I have really learnt a lot from you, thank you!

This study would not have been possible without the support and contribution of the people of Sissala East and West Districts. You were all tremendous and helpful and made work in an unfamiliar place interesting and easy. Thanks to all the institutional heads, their representatives and the smallholder farmers who took time off their busy schedules to participate in the study. A heartfelt appreciation goes to Tonia, my assistant and interpreter, Mike, Pheube, Augustine, KB and all the others whose names are not mentioned here, I am truly thankful for your support.

Last but not least, I am very grateful to all my friends, course mates and lectures for the numerous roles they played in making my studies a success. Thank you all very much and may God bless you.

**DEDICATION**

TO MY PARENTS AND SIBLINGS FOR THEIR LOVE



**TABLE OF CONTENTS**

DECLARATION .....	i
CERTIFICATION .....	ii
ACKNOWLEDGEMENT .....	iii
DEDICATION .....	iv
ABSTRACT .....	xiii
CHAPTER ONE	
INTRODUCTION .....	1
1.1 Chapter Outline.....	1
1.2 Background to the Study .....	1
1.3 Statement of Research Problem.....	3
1.4 Objectives .....	6
1.5 Hypothesis and Research Questions.....	6
1.6 Justification of the Study .....	7
1.7 Organization of the Study.....	8
1.8 Definition of Terms .....	8
1.9 Summary.....	11

## CHAPTER TWO

LITERATURE REVIEW .....	12
2.1 Chapter Outline.....	12
2.2 Empirical Review .....	12
2.2.1 Smallholder farming and climate change .....	12
2.2.1.1 Smallholder Farming and Climate Change Adaptation in Ghana.....	17
2.2.1.2 Smallholder Farming and Adaptation to Climate Change in the Sissala East and West Districts .....	18
2.2.2 Institutions and Climate Change Adaptation .....	20
2.2.2.1 Institutional Support and the Ability of Smallholder Farmers to Adapt	25
2.2.2.2 Institutions and Adaptation in Ghana.....	28
2.2.2.3 Institutions and Adaptation in Northern Ghana .....	29
2.2.4 Challenges Smallholder Farmers Face in Accessing Institutional Support	30
2.2.5 Problems Institutions Face in Providing Support to Smallholder Farmers.	32
2.2.6 Improving the linkages between Institutions and Smallholder Farmers.....	36
2.3 Conceptual Framework.....	37
2.3.1 Impacts of Climate Change.....	37
2.3.2 Barriers to Climate Change Adaptation .....	38
2.3.3 The Role of Institutions in Achieving a Sustainable Livelihood through Adaptation .....	41
2.4 Summary.....	46

## CHAPTER THREE

METHODOLOGY .....	49
3.1 Chapter Outline.....	49
3.2 Research Paradigm .....	49
3.3 Research Methods.....	50
3.4 The Study Districts .....	50
3.4.1 The Sissala East District .....	51
3.4.2 The Sissala West District.....	53
3.5 Unit of Analysis.....	54
3.5.1 Sources of Data.....	56
3.5.2 Target Population.....	57
3.5.3 Sampling Techniques.....	58
3.5.4 Data collection instruments and procedures .....	60
3.6 Data Management and Procedures of Analysis .....	61
3.6.1 Data Editing .....	61
3.6.2 Technique of data analysis.....	62
3.6.3 Ethical Issues .....	64
3.7 Limitations of the Study .....	65
3.8 Summary.....	67

## CHAPTER FOUR

DATA ANALYSIS.....	68
4.1 Chapter Outline.....	68
4.2 Bio-Data of Respondents.....	68
4.3 Institutions Operating in the Districts.....	70
4.3.1 Activities of the institutions in the study districts.....	70
4.4 Respondents Perception on the Occurrence of Climate Change .....	71
4.4.1 Rainfall.....	73
4.4.2 Temperature .....	77
4.4.3 Respondents' perceptions on the causes of climate change.....	79
4.4.4 Observed impacts of climate change on farming activities. ....	81
4.5 Actions Farmers Have Taken to Adapt to Climate Change .....	82
4.5.1 Measures Undertaken by Farmers and their Effectiveness.....	83
4.6 Access to Institutional Support in the Study Area.....	86
4.6.1 Rate of access to institutional support in the study districts .....	86
4.6.2 Institutions from which farmers in the study districts received adaptation support .....	87
4.5.3 Influence of sex to access to institutional support in the two districts.....	90
4.5.4 Influence of Age on Access to Institutional Support in the Two Districts .	91
4.7 Coping Strategies Adopted by Households .....	92

4.7.1	Coping strategies adopted by households before receiving institutional support .....	93
4.7.2	Coping strategies of households not receiving support .....	96
4.8	Effect of Institutional Support on Smallholder Adaptation.....	99
4.9	Challenges smallholders face in accessing institutional support.....	99
4.10	Challenges Institutions Face in Providing Support to Farmers .....	101
4.10.1	Internal barriers to institutional support.....	101
4.10.2	Demand-side barriers that hinder institutional support.....	103
4.11	Improving the Linkage between Smallholder Farmers and Institutions.....	104
4.12	Summary .....	106
CHAPTER 5		
DISCUSSION OF FINDINGS .....		107
5.1.	Chapter Outline.....	107
5.2	Institutions Operating in the Districts.....	107
5.3	Respondents Perception on Climate Change.....	108
5.4	Observed Impacts of Climate Change on Farming Activities.....	110
5.5	Actions Farmers Have Taken to Adapt to Climate Change .....	111
5.6	Effect of Institutional Support on Smallholder Adaptation.....	112
5.7	Challenges Farmers Faced in Accessing Institutional Support .....	113
5.8	Problems institutions face in providing support to farmers.....	114
5.9	Improving the linkages between Institutions and Smallholder Farmers .....	114

5.10	Summary .....	114
CHAPTER 6 .....		116
SUMMARY, CONCLUSION AND RECOMMENDATIONS.....		116
6.1	Chapter Outline.....	116
6.2	Summary of Findings .....	116
6.3	Conclusion.....	118
5.4	Recommendations .....	119
REFERENCES .....		122
APPENDICES .....		134

**LIST OF TABLES AND FIGURES****Tables**

Table 1	Classification of institutions involved in adaptation	70
Table 2	Differences in mean annual rainfall experienced in Wa in P1 and P2	74
Table 3	Differences in Wa's mean annual temperature (1960-2010)	78
Table 4	Respondents perceptions on the causes of Climate Change	80
Table 5	Observed Impacts of Climate Change in the Districts	81
Table 6	Impacts of Climate Change on Farming	82
Table 7	Measures taken by farmers to handle the climate problem	85
Table 8	Farmers' access to institutional support	86
Table 9	Institutions by location of beneficiaries	90
Table 10	Age of respondents and their access to institutional support	92
Table 11	Coping strategies employed by households with institutional support prior to receiving support	94
Table 12	Coping strategies adopted by respondents without access to institutional support	98
Table 13	Issues that affected respondents access to institutional support	100
Table 14	Respondents views on how institutional access can be improved.	105

**Figures**

Fig. 1	The diagnostic framework to barriers to climate change	40
Fig. 2	DFIDs Sustainable Livelihoods Framework (2000)	42
Fig. 3	The modified framework to guide the study	45
Fig. 4	Number of years respondents have observed climate change	75
Fig. 5	Annual trend of rainfall in Wa for Period 1 and Period 2 (P1 and P2)	77
Fig. 6	Trends in Annual Temperature for Period1 and Period 2 (P1 and P2)	79
Fig. 7	Farmer's reaction to climate change – whether to adopt or not	83
Fig. 8	Number of households which received support per institution	88
Fig. 9	Proportion of respondents who faced challenges in accessing institutional support	100

## ABSTRACT

The main objective of this study was to measure the effectiveness of formal institutional support on the ability of smallholder farmers to adapt to climate change, using the Sissala East and West Districts of Ghana as cases. The study was also pursued to find out the challenges institutions faced in providing support while investigating the factors that hindered smallholder farmers from accessing institutional support. In line with these objectives the study combined both qualitative and quantitative methods. A household survey was conducted using 160 heads of households who were randomly selected. Face to face interviews were organized with 12 heads of institutions involved in agricultural development in the study districts. Selection of institutions was initially purposive but the snowball technique was adopted as the study progressed. Quantitative data from the field was subjected to statistical analysis such as chi-squares tests and presented in the form of frequencies and percentages. The research findings indicate that, there is a significant effect in the influence of institutional support in adaptation. Furthermore, findings show that, age and gender had no significant correlation with access to institutional support but rather the nature and kind of adaptation project or intervention introduced by institutions determined which sex group benefitted most from institutional support while financial capital and trust counted in the case of private institutions. Based on the findings, the study recommended that, institutions must develop innovative ways of spreading out their reach (such as outreach on market days) in order to aid farmer adaptation throughout the districts while smallholder farmers are encouraged to take opportunity of the Free Compulsory Universal Basic Education programme and educate their children to make them likely to be considered for employment in their local institutions to enhance communication flow between farmers and officials of institutions.

## CHAPTER ONE

### INTRODUCTION

#### 1.1 Chapter Outline

This chapter is the general introduction to the study. It starts with a comprehensive background then continues with the statement of the research problem and the objectives of the study. The hypothesis, research questions and justification of the study follow respectively. The closing sections of this chapter discuss how the study was organized, definition of terms and concludes with a short summary.

#### 1.2 Background to the Study

The Intergovernmental Panel on Climate Change (IPCC) is certain that the earth's climate is changing and has shown with evidence in its fifth assessment report (AR5) the impacts of climate change on specific geographical regions, sectors and systems globally (IPCC, 2013). Scientific studies have shown that, although all sectors and people worldwide will be affected by climate change, the vulnerability and rate of exposure will be exacerbated by non-climatic stressors which are usually embedded in social and cultural processes such as gender, ethnicity, and class which result in inequalities (*ibid*). Unfortunately, parts of the world which have been identified to be most vulnerable to climate change also depend on climate sensitive sectors chiefly agriculture for their economic development and also have low capacities to adapt (UNFCCC, 2007a).

Agriculture in developing countries for instance is estimated to employ more than 1 billion people representing about 48% of the worlds' labour force (ILO, 2014).

Agriculture is also recognized as the economic advantage of most developing countries though it is rain-fed and practiced on a smallholder non-mechanized basis in rural locations (FAO, 2001). Smallholder farmers contribute about 80% of food needs in developing countries (FAO, 2012) and use up a significant percentage of global land (UNFCCC, 2014). However, despite their large numbers and contribution to food security and economic needs, smallholder farmers are most at risk to climate change and its impacts. Their vulnerability results mainly from their dependence on the weather and in certain cases, their location in areas that are vulnerable to climate risks such as dry lands, marginal areas and low latitudes (Altieri and Koohafkan, 2008; UNFCCC, 2007b).

Climate change is one of the many problems farmers and those employed in the natural resource sector contend with in their line of production (Munasinghe, 2001). This is because, climate induced impacts on the environment have been discovered to affect the sustainability of the livelihoods of people engaged in the natural resource sector as it interacts with existing pressures on their livelihoods (IPCC, 2013). Effective steps to ensure successful adaptation is therefore needed to increase their resilience to climate change (Taskforce on Climate Change, Vulnerable Communities and Adaptation, 2003).

Research by individuals and organizations have proposed adaptation that leads to sustainable development as the key to improving Africa and poor countries' resilience to climate change impacts (IPCC, 2013; Piya *et al.*, 2003). Adaptation to climate change can be undertaken on different levels or can take different forms (Smit and Pilifosova, 2003). These are on the individual level (which may be at the farm level), national or international stages, either as a reactionary activity or a proactive reaction (*ibid*). From the studies conducted by Maddison (2007) and Smit and Pilifosova (2003), one comes to

a realization that, although there may be some autonomous adaptation at farm-level, there needs to be some form of institutional intervention to make adaptation successful. Rodima-Taylor *et al.* (2011) postulated that, all kinds of social institutions, be they formal or informal, initiated externally or internally are equally important in the process of adaptation and innovation and therefore are important focal points in adaptation.

Throughout history, human societies have adapted to different changing climatic situations by employing different strategies (The World Bank, 2013). However, the capacity of the human social systems ability to adapt depends on specific institutional arrangements operating within the society (Agrawal, 2010). In countries where institutions are stable and working well, climate change adaptation is to a certain extent more successful as resources are made ready towards planned adaptation and this is true in the case of developed countries (Smit and Pilifosova, 2007). In developing countries on the other hand, institutions are generally poorly developed and in some cases non-existent, thus reducing the capacity of local actors to adapt (*ibid*). Similarly, Brooks *et al.* (2005) posits that, adaptation in human systems is successful when governance institutions, civic and political rights literacy systems are working well and linked to the adaptation process.

### **1.3 Statement of Research Problem**

It is generally believed that, food insecurity has become a major problem in many parts of the world especially in developing countries. Thousands of people are either malnourished or under fed. Food production keeps falling against a rapid population growth (Population Action International, 2011). Climate change is attributed as one of the causes of falling agricultural yields in many parts of the world especially in vulnerable areas

such as Africa, where agriculture is rain dependent and non-mechanized (Rosenzweig and Parry, 1994). Climate related losses are recorded throughout the agricultural value-chain, from production through harvesting to marketing (Stathers *et al.*, 2013). In all these scenarios, the smallholder farmer is least resilient to handle unexpected climatic shocks and its resultant losses.

Adaptation has been proposed as the best form of response to climate change especially amongst smallholder farmers (Thornton, 2006). Considering the role smallholder farmers play in food security, national and local institutions are needed to help increase the adaptive capacity of the smallholder farmer. Over the years, smallholder farmers in Sub-Saharan Africa and northern Ghana in particular have had to adapt to variable climatic conditions (Nigigi, 2009). However, it has been realised that, adaptation to climate change requires specific institutional arrangements (The World Bank, 2013). This makes the role of institutions in adaptation very important (IPCC, 2013) as they shape the response and strategies of households to climate change (Agrawal, 2010). The intent of this study therefore, is to analyse the influence of institutional support in climate change adaptation amongst smallholder farmers.

Institutional support to climate change adaptation will be measured against a framework developed purposively for this study. The framework is a systematic approach that takes into account the characteristics of the rural economy, impacts of stresses (climate change) on rural livelihoods while highlighting existing social institutions and their interconnections with other institutions at the higher level.

Ghana is a decentralized state with resource flowing from the state, through the regions to the districts, which happens to be the lowest level of governance. The district assembly system in Ghana is the driving force for local initiatives in relation to planning, delivery of social services and participation of all people in decision-making process as democracy demands (IDG, 2010). Districts in Ghana are financed through the District Assemblies common fund and are established by an act of parliament (Ghana, 1992). Each ministry of the central government is represented in all the districts.

The study areas for this research are the Sissala West and East Districts located in the Upper West Region of Ghana, within the Guinea Savannah zone. The Sissala West District was carved out of the Sissala East District in 2008 under LI 1746 (Ministry of Local Government and Rural Development and Moks Publications and Media Services, 2006a). Therefore as mandated by law, local representatives of the central government operate within the confines of the districts. The two districts are predominantly agrarian with a large proportion of their populations involved in smallholder farming. These districts are found within a region which has been described to be one of the most vulnerable regions in Ghana to climate change (Darko and Atazona, 2013 and Stanturf *et al.*, 2011). This may be due to the dry nature of the region, dependence on rain-fed farming for their livelihoods, limited sources of alternative income generating strategies, decreasing soil fertility among others (Stanturf *et al.*, 2011). All of these challenges tend to have effect on the vulnerability context of the people with impacts on the food security situation of households within the region.

#### **1.4 Objectives**

The main objective of this study is to investigate the effectiveness of institutional support in climate change adaptation amongst smallholder farmers in the study districts. The study sought to achieve this broad objective through four specific objectives namely:

- To examine the influence of institutional support on the ability of smallholders to adapt.
- To find out the challenges smallholder farmers face in accessing institutional support
- To identify the problems institutions face in providing support to farmers.
- To find out how the linkage between institutions and smallholder farmers and institutions can be strengthened to remove obstacles and improve relations?

#### **1.5 Hypothesis and Research Questions**

This thesis adopts the use of both qualitative and quantitative methods. Therefore, both a hypothesis and research questions guided the study to reach its objectives. The first objective of this study was tested against a hypothesis. This is because it sought to measure the effect of institutional support in the two districts. The hypothesis is stated below:

$H_0$  = There is no significant difference in the influence of institutions in adaptation of smallholder farmers to climate change in the Sissala East and Sissala West Districts

$H_1$  = There is a significant difference in the influence of institutions on smallholder farmer adaptation in the Sissala East and Sissala West Districts

Objectives two, three and four on the other hand were achieved by answering three research questions which have been listed below:

- What challenges do smallholder farmers face in accessing adaptation support from institutions?
- What factors hinder the efforts of institutions to provide adaptation support to smallholders?
- How can the linkage between institutions and smallholder farmers be strengthened to remove obstacles and improve relations?

#### **1.6 Justification of the Study**

Years of research has shown that, smallholder farmers in least developed countries need the support of institutions to aid adaptation. This is because, adaptation to climate change is location specific (IPCC, 2013) and also, as the adaptive capacity of an individual or a community is dependent on the regulative processes and structure of institutions and their interactions with each other both locally and externally (Agrawal, 2010). Additionally, institutions are important focal points to consider when determining the direction and magnitude of flows of resources to different social groups (*ibid*). Rodima-Taylor *et al.* (2011) described institutions as having the ability to shape an individual's decisions and choices by barring or allowing certain actions or outcomes through procedures, rights and duties. Thus, making institutions the source of constraints, rewards or punishment that affect a person's decision to adapt or not (*ibid*).

This study attempted to find out if the conjectures by earlier researchers holds true in the Ghanaian situation. The results of this study aims to address barriers that restrict

individuals' access to institutional support. The study will therefore help in identifying effective ways institutions can support adaptation and rural development.

This study is very useful to organizations that are involved in adaptation at the community level such as NGOs and district assemblies. Financial institutions may also find it handy when developing adaptation plans and projects for smallholder communities.

This study attempts to explore the function of institutional support in smallholder adaptation in Ghana, using the Sissala East and West Districts of Ghana as the study areas. The thesis tries to find out the modifications in smallholder adaptation and its resultant influence on agricultural productivity within the district because of institutional support. Analysis of the adaptation capacity of farmers in the districts is to be considered while reviewing the role gender plays in institutional access and adoption of agricultural innovation.

### **1.7 Organization of the Study**

This report is written in six chapters with this chapter being the first. The immediate chapter after this is the literature review. Chapter Three introduces the study districts and describes the methods used in data collection and analysis. The results of data analysed from the field are presented in Chapter Four while Chapter Five presents the discussion of findings. The report finally closes in Chapter Six with a set of recommendations.

### **1.8 Definition of Terms**

**Adaptation** in this study is defined according to the IPCC's explanation, which refers to processes by which strategies to moderate, cope with and take advantage of the

consequences of expected or actual climatic events are improved upon, developed, and implemented in order to reduce harm or take advantages of its beneficial benefits.

**Climate change:** This study adopts the UNFCCC's definition of climate change which is explained as a change of climate that 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 times (UNFCCC, 2013)

**Climate change impacts** refer to the actual or perceived effects of climate change on the environment and society. Examples include extreme weather events, sea-level rise and temperature increases.

**Institutions:** The term institution is often used interchangeably with the word organizations both in speech and in literature. According to Uphoff and Buck (2006), institutions are complexes of norms and behaviours that persist over a long period in time by serving socially valued purposes. Institutions have also been identified to exist to shape human interaction by establishing a stable structure through which the set down rules (formal) and norms (informal) that characterize human behaviour in a given situation (North, 1990). Institutions exist to define human behaviour by prescribing a set of constraints (norms of behaviour, conventions and rules) and incentives which affect individual choices which in the long run affects the output of economies and societies (North, 1990). In this case, institutions encompass all the elements of culture including family and religion as they also constrain human behaviour. Organizations on the other hand, refer to a collection of people involved in recognized and accepted roles that serve definite purposes which may be specialized or interdependent (Uphoff and Buck, 2006;

Gortner *et al.*, 2007; North 1990). From these definitions, one realizes that, some institutions can be organizations or vice-versa while some institutions and organizations fall purely within range as institutions or organizations. This study will however be more concerned with formal institutions that have organizational basis such as agencies, departments, and NGO's (Uphoff (n.d); Pradhan *et al.*, 2012).

Based on Agrawal and Perrin (2008) definition for institutions, this study will define institutions as structured formal or informal organizations that serve as the means through which local households and societies cooperate with each other, share decision and take collective action. They can also be defined as organizations through which central governments and donors channel resources for local development (*ibid*).

**Smallholder farmers:** This study adopts the definition of Morton (2007) for smallholder and subsistence farmers as farmers, whose production can be found on a continuum between subsistence production and concentration on crop production for the market.

**Resilience** as defined by UNISDR (2009) refers to the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.

**Vulnerability** in this report refers to the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of hazards (adopted from UNISDR, 2009).

## **1.9 Summary of Chapter**

This chapter opened with a brief background to the study. From the discussion, it emerged that, climate change is one problem that could affect the sustainability of smallholder farming making adaptation very necessary (Munasinghe, 2001; Piya *et al.*, 2003; Alteri and Koohafkan, 2008 and IPCC, 2013). However, as institutions have been identified to shape the response and strategies of households to climate change their role in the adaptability of smallholder farmers to climate change cannot be underestimated (Agrawal, 2010; Smit and Pilifosova, 2003). To be able to achieve this purpose, the study was guided by a set of specific objectives which translated into a set of hypothesis and research questions. A section within this chapter briefly describes how this thesis is organised. The chapter finally closes by explaining some key terms as they fit into the study.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Chapter Outline

This chapter deals with the review of literature related to the study from sources such as study reports, abstracts, working papers, peer reviewed and non-peer reviewed journal article and books. The chapter is divided into two parts- the empirical review which looks at studies which have been conducted around the topic of this thesis and the conceptual framework. This chapter ends with a summary on the review conducted.

#### 2.2 Empirical Review

The empirical review is organized under five main themes. All the themes except the first one coincide with the study objectives. The first section of the review looks at studies conducted on climate change and smallholder farming. In line with the main objective, the second section of this review examines studies that assess the role institutions play in adaptation. The subsequent sections of the empirical review address studies conducted on problems institutions face in offering adaptation support to smallholder farmers and how the linkages between institutions and smallholder farmers can be improved to enhance access to support.

##### 2.2.1 Smallholder farming and climate change

Smallholder farming has been described to be one of the most challenging ventures within the natural resource sector in the face of climate change (Morton, 2007). This is

due to the reliance of smallholder farmers on unpredictable climatic variables- rainfall and temperature- as their main source of productivity (Altieri and Koohafkan, 2008). These very elements will be impacted by climate change bringing about changes in precipitation and temperature resulting in floods and droughts which will affect the productivity of smallholder farmers (Ngigi, 2009). Studies have also identified smallholder farmers to suffer from a myriad of problems such as poverty, land tenure, falling in yields, access to markets, capital and other economic resources which have the effect of narrowing their security to climate change (Morton, 2007; Collier and Dercon, 2009). These notwithstanding, smallholder farmers especially those in Sub-Saharan Africa are recognized to be important to food security considering the large numbers of people they feed (Cooper *et al.*, 2008).

Although smallholder farmers have been identified to make a proportionally small contribution to the problem of climate change, this phenomenon is noted to have the tendency of increasing smallholder farmers' susceptibility to crop failure, animal pests and diseases, loss of soil fertility, livelihood insecurity, out-migration, bad health and low education (IPCC, 2013; Morton, 2007; Alteri and Koohafkan, 2008). What even makes the picture gloomier for smallholder farmers is that, climate change can merge with the other challenges already facing smallholder farmers and make them even more vulnerable (Rahman, 2008; IPCC, 2013 ). This will have implications on the farmers, their nations, the world at large and the possibility of achieving the MDG 1 (Rahman, 2008).

Smallholder farmers have been recognised to produce a bulk of the world's food needs (Wolfensen, 2013). Most smallholder farmers are found in developing countries where

they live and work in difficult environments that are ecologically and climatically vulnerable (FAO, 2012). They are also characterised by their over reliance on the weather to be able to undertake their economic activity and high poverty rates (FAO, 2011). These exposures make smallholder farmers in the developing world highly vulnerable to climate change considering the fact that they tend to lack the financial and technological capacities to adapt to climate change (Jayne *et al.*, 2010). Studies have shown that, farmers in the tropics have had to deal with climate variability throughout history as this portion of the globe is affected by the El-Nino Southern Oscillation which brings about droughts and floods accounting for yield variation in major staples (Zhao *et al.*, 2005). Due to these historical variations in climate, smallholder farmers on their own have developed strategies with which to cope with climate variability (Rahman, 2008; Alteri and Koohafkan, 2008). However, these traditional coping mechanisms are not enough on the medium to long term, to help smallholder farmers effectively deal with the quick occurring anthropogenic climatic change being experienced in this era.

Adaptation to climate change has been identified to be the best response to be undertaken by the poor especially those involved in the natural resource sector in developing countries such as smallholder farmers (Tubiello, 2012; World Bank, 2013). This, according to Smit and Pilifosova 2003, can be undertaken as a reactionary or a proactive action towards climatic events on the household (farm level), local, national and international levels. At each of these levels, specific decisions need to be taken which will also need requisite actions and in some cases constant financial commitments to reduce maladaptation.

Furthermore, a series of studies have shown that, diversification by smallholder farmers especially those in Africa, is an old practice which is not only limited to on-farm activities, but also off-farm actions (Ellis, 2000; Agrawal *et al.*, 2010; Abdulai and CroleRees, 2001; Alteri and Koohafkan, 2008). Empirical studies reveal that, although external shocks and trends such as climate change impacts affects the diversification choices of rural households, they found out that, the economic soundness of farming households determined what choice they would implement (Ellis, 2000; Agrawal *et al.*, 2010; Abdulai and CroleRees, 2001). These economic indices are explained include availability of assets, risk management, gender relations, and age which interact to determine the capacity of the households to adapt and also the adaptation strategy to be selected by farming households (Hussein and Nelson, 1998; Ellis, 2000)

Based on the above discussion, a set of scholars followed up by studying the climate change adaptation strategies employed by smallholder farmers. The first group of studies identified four main groups of adaptation strategies. These are mobility, diversification, community pooling and storage (Agrawal and Perrin 2008; Agrawal, 2010; Agrawal *et al.*, 2010) the second group of studies which included Harvey *et al.* (2014) and Magombo *et al.* (2012) identified five main adaptation strategies which includes all those stated above and market access. This has been effectively contested by Agrawal and Perrin (2008) who describes market access as having the ability to replace any one of these strategies within an economy where market access is available. An argument to which this study agrees as the level of access smallholder farmers have into markets in terms of distance, pricing, transport and quality of infrastructure all affect the determinants of diversification in the food production industry as documented by Birthal and Joshi

(2009). Thus easy access to the labour market will determine whether farmers in rural areas will be able to sell their labour elsewhere. Again, the diversification choice of many a rural farmer will be affected by the knowledge that, the other venture to which he subscribes is marketable with free cash flows.

Conversely, Ellis (2000) described all the strategies discussed above to be coping strategies if they were implemented as a result of necessity rather than choice. This is because, livelihood strategies taken as a result of a pressing need can only help households cope to the present changes being experienced and may not apply on the long term (*ibid*). Thus adaption planning targeted at meeting the long term effects of climate change is needed in order to ensure successful adaptation. Agrawal (2010), reasons from his studies that, to achieve effective adaptation, there needs to be some amount of institutional support to ensure that rural households can receive enough information both on climate change and also adaptation choices so as to implement adaptation practices that are relevant to their needs. This is to ensure that, adaptation reduces the vulnerability of smallholder households and communities by building on and improving upon the coping strategies, assets and incorporating the vulnerability reduction in all policies (Mitchell and Tanner, 2006).

However, before discussing institutions and adaptation, a review on studies on smallholder farming and climate change in Ghana will be discussed to find out the situation in Ghana.

### **2.2.1.1 Smallholder Farming and Climate Change Adaptation in Ghana**

Empirical studies on the climatic patterns of Ghana by Owusu and Waylen (2009) showed that, significant changes in rainfall and temperature have been recorded over the years throughout the country. These changes might have serious implications on smallholder farmers as their production is largely rain-fed and non-mechanized thus, increasing their vulnerability to climatic shocks (MoFA, 2007). Consequently, studies conducted to find out Ghanaian farmers' perception to climate change indicates that, farmers in all the agro-ecological zones in Ghana have for some years now, experienced changes in weather patterns, with effects on farming activities (Kusakari *et al.*, 2014). Major changes farmers have reported include changes in the amount and pattern of rainfall and increasing temperatures which have been noted to result in shifts in dates of rainfall season, variations in the duration and intensity of rainfall and longer periods of droughts (Kemausuor *et al.*, 2011).

Studies which reviewed the adaptation strategies used by smallholder farmers to climate variability have shown that, smallholder farmers engaged in food production in Ghana combine farming systems and strategies such as sedentary farming, shifting cultivation, inter-cropping and mixed cropping, to help them cope with food insecurity (Stanturf, *et al.*, 2011). Ofori-Sarpong and Asante (2008) posits that, farmers in southern Ghana tend to practice more ecologically sustaining practices such as, intercropping, agroforestry and the use (and) or maintenance of local food crop genotypes to ensure their adaptability to climate change. Stanturf *et al.* (2011) on the other hand reports that, some of the coping strategies adopted by people in northern Ghana such as charcoal burning tend to degrade and put pressure on the environment.

Literature review on adaptation studies conducted in Ghana shows that, adaptation is dependent on variables such as household assets, markets and institutions (Asmah, 2011; Marchetta, 2008). By these studies, households that have more access to any one or all of these resources were found to be able to adapt successively and vice versa. Again, depending on the geographical location of the household, age and gender of household head, season of the year, access to these elements which will aid adaptation might be different (Asmah, 2011). Thus, causing different people to feel the impacts of climate change in ways that is unique to their setting. This will therefore beg us to look into studies that have analysed smallholder farming and climate change northern Ghana and the Sissala East and West Districts which happen to be the study areas of this thesis.

#### **2.2.1.2 Smallholder Farming and Adaptation to Climate Change in the Sissala East and West Districts**

Studies conducted by Kranjac-Brisavljevic *et al.* (1999) and Yengoh *et al.* (2010) show that, although the climate of northern Ghana has always been variable, the past 60 years the nature of the climate had become more variable. These two studies together came out that, variations have been recorded in the onset of rains, the length and frequency of dry and wet spells, occurrence of extreme events, temperature and evapotranspiration (*ibid*). Kranjac-Brisavljevic *et al.* (1999) particularly observed that, the rainy season of northern Ghana had shifted is delayed and lasts for a shorter period. While the studies of Kusakari *et al.*, 2014 and Amikuzunu and Donkor (2012) observed that, the occurrence of intermittent droughts and floods in northern Ghana is now common. These climatic stressors were recognized by Kasei *et al.* (2014) as having effect on the agricultural activities of the people.

Studies which reviewed the adaptation strategies of farmers and households in northern Ghana describe migration and on-farm diversification as the two major adaptation strategies (Marchetta, 2008 and Laube *et al.*, 2012). Marchetta (2013) found out that, migration as an adaptation strategy was taken on by households as a last resort when there were no further opportunities to develop non-farm activities or in situations where access to fertile land is scarce. Thus making migration as an adaptation strategy incapable of improving the resilience of households to shocks (Marchetta, 2013). Laube *et al.* (2012) also found out that, dry season vegetable irrigation is a practice now catching on with households. However, the study argues that, when farmers undertake this strategy on their own, they tend to have difficulties in assessing markets due to unfair market dynamics (*ibid*). Furthermore, Marchetta (2013) outlines that, adaptation strategies taken on by households and individuals in northern Ghana vary by location and opportunities. While some households tend to practice intensive or extensive cultivation depending on the availability of land, it is argued that, in areas where there is mineral concession, young people especially males tend to get involved (Marchetta, 2013). Stanturf *et al.* (2011) also identified processing, tree cropping and charcoal burning as other livelihood strategies taken up by people in response to climate change.

From all the studies reviewed from the international through national to the local level, one would realize that, smallholder farmers have developed various ways to cope with variations in climate. However, most scholars posit that, for adaptation to be successful to meet the long term needs of the smallholder farmer, there should be some form of institutional backing (O’Riordan and Jordan, 1999; Tompkins *et al.*, 2010; Smit and

Pilfisoa, 2007; Agrawal 2010, Agrawal and Perrin 2008, Agrawal *et al.*, 2010). This will be discussed into details in the following section.

### **2.2.2 Institutions and Climate Change Adaptation**

The capacity of a community or region to adapt to climate change is dependent on many factors. These include their economic wealth, technology, information and skills, equity and institutions (Smit and Pilfisoa, 2007). Amongst these indicators, the role of institutions in adaptation cannot be underestimated. This is because institutions possess the character of bringing people together to make them act collectively to achieve results and also have the ability to combine the elements that result in the achievement of adaptive capacity (Agrawal, 2010; Agrawal and Perrin, 2008; and O’Riordan and Jordan, 1999). Adapting to climate change involves actions that aim at risk and vulnerability reduction, creation of opportunities and building the capacity of groups, individuals and natural systems to cope with climate impacts while at the same time taking and implementing strong decisions to ensure a successful adaptation process (Tompkins *et al.*, 2010). Again, adaptation to climate change has been identified to be a socio-institutional learning process that distinguishes stakeholder goals and processes and uses information at various levels and in many ways (Ziervogel and Ericksen, 2010).

All of these elements in adaptation involve a certain amount of financial commitment, research and legal backing. This is because, every adaptation option available to individuals and communities require key factors to be considered such as geographical and socio-cultural setting, age, gender, wealth among others (IPCC, 2013). Apart from these, adaptation to climate change is location specific due to the differentiated nature of societies’ exposure and impacts (Agrawal and Perrin, 2008; Penalba *et al.*, 2012; IPCC,

2013). Adaptation cannot therefore be achieved without any form of institutional support or linkage as they provide the needed environment for the implementation of adaptation options (Moser and Ekstrom, 2010). This therefore makes institutions- especially those at the community level- in the climate change discourse very important as they are vital in shaping adaptation and improving capabilities of the most vulnerable social groups within the society (Agrawal and Perrin, 2008 and Penalba *et al.*, 2012).

Studies by Smit and Pilfisoa (2007) show that, countries that have well developed institutions possess greater adapting capacity than countries whose institutions lack effective institutional set-ups. This is because the political process and power relations among and within countries and communities affect the efficiency of the institutions (Kelly and Adger, 2000). Agrawal and Perrin (2008) and Rodima-Taylor *et al.* (2011) describe institutions to be omnipresent and serve diverse purposes in the course of adaptation and therefore are essential in ensuring a successful adaptation. Again, institutions affect individual and community behaviour through their sets of norms and procedures that legalize behaviour and control its effects thereby creating incentives for adaptation (Agrawal *et al.*, 2010). Institutions have also been identified to structure environmental risks and vulnerability through their research, skill-building functions and collaboration with other decision makers (Agrawal and Perrin, 2008).

However, within the social system, there are different types of institutions that control human interaction (Uphoff and Buck, 2006; Agrawal, 2010; Agrawal and Perrin, 2008; Agrawal *et al.*, 2010 and Gortner *et al.*, 2007). From literature, three types of institutions were identified these are, private, public and civic or participatory institutions (Uphoff and Buck, 2006; Agrawal and Perrin, 2008; Agrawal *et al.*, 2010). However, Gortner *et*

*al.* (2007) in their study of institutions and organizations argues that, institutions exist on a continuum which sometimes overlaps as there is no clear cut distinction between the private, public and the middle range institutional types.

Public sector institutions have been identified to exist to provide services need to meet the need of the people they serve as prescribed by the laws that establish them (Gortner *et al.*, 2007). They usually possess authoritative action and have the ability to direct financial and technical resource into rural areas and act in ways the public wants as they most often find themselves in office through the electoral system (Agrawal *et al.*, 2010; Gortner *et al.*, 2007). Due to this reason, public institutions on the local level have been recognized to have a higher capacity to channel resources to providing adaptation support in strategies related to community pooling, storage and diversification (Agrawal *et al.*, 2010). Private institutions on the other hand possess for-profit goals, have more financial resources and are more likely to venture into adaptation strategies that promote market exchange and in a few cases communal pooling (Agrawal, 2010). Civic and participatory organizations due to their flexibility are able to redefine their goals to adopt new procedures and improve upon different adaptation strategies (Agrawal and Perrin, 2008). Again, institutions are described to exist in two forms- formal and informal (Uphoff and Buck, 2006; Agrawal and Perrin, 2008; Agrawal *et al.*, 2010). In the process of adaptation, informal institutions have been identified to be the initiators of adaptation actions in human societies (Dixit *et al.*, 2009), while, formal institutions are noted to develop strategies and improve upon the response strategies established by informal institutions so as to make interventions sustainable and reduce maladaptation (Agrawal, 2010). This is demonstrated in the findings of Nadeem *et al.* (2010) who studied the role

of local governance in strengthening the adaptive capacity of water governance systems and flood mitigation infrastructure in Nepal and India.

Institutions involved in climate change adaptation have been recognized to exist in a hierarchy ranging from the local level, national to international level (Agrawal, 2010; Agrawal and Perrin, 2008; Moser and Ekstrom, 2010 and IPCC 2013). Thus, Ziervogel and Ericksen (2010) call for the analysis of institutional response to adaptation at the different levels of governance during adaptation studies. National governments for instance have been identified to lead in the adaptation agenda by deciding on the funding priorities and trade-offs; promoting institutional structures and providing policy direction to the lower levels of governance to guide adaptation (IPCC, 2013).

Though the contribution of institutions on each level cannot be ruled out, institutions at the local level have been identified to be the most important in adaptation as the most important influence institutions have on adaptation is seen and felt at the local level (Agrawal and Perrin, 2008). This is because apart from controlling human behaviour, institutions at the local level control the ability of households and individuals to adapt by incorporating old and new processes and policies into the system to facilitate adaptation. (Hall *et al.*, 2006; Agrawal and Perrin, 2008). The influence of local institutions is felt through practices such as risk sharing, shaping the nature of responses by individuals or households to community level adaptation through the organization of an incentive structure and by mediating and shaping external interventions into the local context (Agrawal and Perrin, 2008). Institutions involved in adaptation at the local level have also been found to have the ability of strengthening existing coping strategies and make them more sustainable and in some cases introduce new adaptation strategies that meet

the adaptation needs of households and communities they serve (Agrawal, 2010). Again, institutions in rural areas have been noted to help in integrating smallholder farmers into the national economic system by applying innovative methods that will make the smallholder farmer more competitive to receive better prices and have access to investment resources. Similarly, Agrawal *et al.* (2010) observed that, for adaptation to be effective local institutions must bear characteristics of responsiveness, flexibility and ability to adapt to the uncertainties that surround climate change.

Agrawal (2010), Agrawal *et al.* (2010) and Tiwari and Joshi (2014) in discussing the effectiveness of institutions in adaptation mentioned that, the interaction between the different types of institutions determine the efficiency of adaptation. Institutions interact with each other in either horizontal or vertical relationship and in some cases both (IPCC, 2013; Tiwari and Joshi, 2014).

Vertical relations describes how the various institutions involved in adaptation on different levels - international, regional, national and local- link and interact with each other (Gehring and Oberthü, 2008). While horizontal relations refer to the interconnections between the different types of institutions on the same level (*ibid*). Therefore in studying the role of institutions in adaptation at the local level, Agrawal *et al.* (2010) suggest that, one has to pay attention to the nature and goals of institutions, how they facilitate particular interventions and how institutions link up with each other and the rural households. This is because, individuals have been documented to adapt through complex multidirectional interactions between institutions and all actors within the system at different scales (Rodima-Taylor *et al.*, 2011). This was demonstrated in the study by Eriksen and Selboe (2012) who studied the social organization of adaptation to

climate variability in Norway and realised that, farmers strategies for managing climate change depended on collaborative exchanges that were dependent on their relationship with informal social networks that depend on trust as well as formal institutions and regulations. The process of facilitating adaptation at the local level involves important actions and decisions that need to be taken by the higher levels of governance (Harmeling *et al.*, 2010). These processes include collection of climate change adaptation information and making it available; provision of human, financial and technical resources to support adaptation at the local level; providing social protection for the vulnerable and creation of policies that will enhance bottom-up feedback processes in the horizontal relations of institutions (*ibid*). This therefore creates a situation where local innovations and adaptations are interlinked with those from the global scene thus, becoming an integral component of adaptation between institutions and actors (Rodima-Taylor *et al.*, 2011).

From the discourse above, one can invariably conclude that, all institutions involved in the adaptation process are interdependent and equally important in the adaptation process. Nonetheless, though power relations exist between and within institutions at all levels, individuals and communities must not be left out as they are the beneficiaries of adaptation thus, determining its success (Eriksen and Selboe, 2012).

#### **2.2.2.1 Institutional Support and the Ability of Smallholder Farmers to Adapt**

The agricultural sector is one that is highly sensitive to many shocks and stresses that may arise from the environment, economic and social changes. Some of these changes occur at a fast rate while others may occur slowly and may be unpredictable in nature (The World Bank, 2013). Farmers will therefore have to adopt new innovations and technologies to help them cope with these changing trends. In recent times, climate

change has emerged to be a great threat to the agricultural sector with smallholder farmers being described to be most at risk due to their dependence on the climate. This is also true because all the parts of the socio-economic system are affected by climate change and changes in climatic variables tend to affect productivity especially in agriculture thereby, leading to price increases and exacerbating poverty especially within smallholder farmers (Ziervogel and Ericksen, 2010).

However, climate variability/change is not a new phenomenon to farmers especially those residing in the low latitudes of the globe as their climate is highly unpredictable. Hence farmers in such regions have developed livelihood strategies to help them adapt to the changes they experience in production as a result of changes in climate patterns. Over the years, studies by various authors and research bodies engaged in climate change studies involving smallholder farmers have advanced that, smallholders usually respond to climate variability/ change by migrating to other areas to engage in either on-farm or off farm activities, growing new varieties of crops, mixed farming, irrigation, communal pooling, storage depending on wild foods and market exchange (Mortimore and Adams, 2001; Agrawal, 2010; Hassan and Nhemachena, 2008). However, the decision of households and individuals to adopt one adaptation technique or the other cannot be taken without any form of institutional influence (Agrawal *et al.*, 2010). This is because, smallholders in most developing countries tend to fall within the poorest segment of the population. To adapt successfully, smallholders must put in some financial commitment to aid them purchase improved inputs and latest innovations needed for adaptation. In the agricultural sector, institutions have been recognized to serve as modes of transmitting innovations and initiatives to farmers and other stakeholders in the sector (Hall *et al.*

2006). Therefore, Hall *et al.*, (2007) stress that, if the different roles, routines and rules that guide the different organizations are governed by specific institutional and policy instruments, the extent to which the welfare of the poor farmer will be protected against the adverse effects of climate change will be increased.

The contribution of institutions to adaptation has been acknowledged by climate authorities including the IPCC (2013) which posits that amongst the institutions that offer adaptation support, those associated with the local level are the most important. These include local governments and the private sector which in this case includes the participatory, civil based organizations and non-governmental organizations. These institutions have been recognized for the roles they play in information sharing and the development of adaptive capacities of individuals (Agrawal, 2010). Again, from the discussion by Ellis (2000) and Smit and Pilifosova (2003), one can understand that, when adaptation is well planned and receives the required institutional backing to ensure its success, adaptation tends to serve its purpose and reduce the impacts of climate change on households and individuals.

Agrawal (2010) and Agrawal and Perrin (2008) found out that, in most cases, public institutions initiate adaptation process. They also found out that, the ability of public institutions at the local level to effectively provide support to smallholder farmers or communities depends on political issues which may impede or enhance the provision of the support. In other cases, officials of public institutions tend to act to suit their benefactors rather than the people whom they have to serve due to the fact that they were either elected or nominated by a higher body (Agrawal, 2010; Measham *et al.*, 2011).

The rate at which households and individuals will be able to access strategies introduced by institutions, is dependent on the rate of access individuals and households have to institutions (Agrawal *et al.*, 2010 and Agrawal 2010). Therefore if farmers and other actors in the agricultural system are to adapt successfully to climate change, they must innovate continuously and within a supportive environment which allows for development in technology, and evolution of institutions (Rajalahti *et al.*, 2008). This can be done by taking on adaptation strategies as innovative approaches that will allow and open up interactions among the various stakeholders especially institutions (*ibid*). Thereby, creating the enabling environment for farmers who happen to be the key actors in the agricultural system to successfully adapt. This point was further elaborated upon by Hassan and Nhemachena (2008) who in studying the determinants of African farmers' strategies for adapting found out that, by increasing farmers access to markets, extension and credit services, technology and farm assets (in the form of labour, land and capital) the ability of farmers to adapt to climate change is improved. To reach this aim, all other stakeholders involved in agricultural development and adaptation must fully participate in the adaptation process (Rajalahti *et al.*, 2008).

#### **2.2.2.2 Institutions and Adaptation in Ghana**

Musah-Surughu and Ahenkan (2014) in their study outlined that, institutions are needed to develop the adaptation capacities of individuals and communities to climate change. Laube *et al.* (2012) and Belden (2010) identified that both formal and informal institutions have roles to play in adaptation. However, as Belden (2010) and Yaro *et al* (2014) points out the relations and interaction between institutions can promote or challenge adaptation efforts. Empirical studies by Stanturf *et al.* (2011); Darko and

Atazona (2013), show that, the adaptation process in Ghana involves all forms of institutions within the vertical column of institutions- international, national and local. International institutions have been recognized to offer funding for implementation of climate change projects sometimes while working together with government or with locally based NGO's (Stanturf *et al.*, 2011). Yaro *et al.* (2014) however reports that, national institutions are not directly involved in adaptation though through policies and service provision they ensure that conditions are met for adaptation and sometimes run adaptation driven projects (Yaro *et al.*, 2014). NGO's on the other hand have been identified to spearhead adaptation by building the capacities of people through education, provision of livelihood choices and introduction of new opportunities (Yaro *et al.*, 2014 and Stanturf *et al.*, 2011). Yaro *et al.* (2014) report that even though private institutions were engaged in adaptation, their activities are usually limited to areas with good road connection and to people who could afford.

Analysis of literature indicated that, many of the studies conducted on institutions and adaptation in Ghana are centred on the natural resource sector with focus on forest management (For example, Kalame *et al.* 2011; Kalame *et al.*, 2009; Mayers *et al.*, 1996; Koku and Gustafssen, 2003).

### **2.2.2.3 Institutions and Adaptation in Northern Ghana**

Northern Ghana is classified as the most vulnerable part of the country to climate change due to poverty, harsh environmental factors, their dependence on the natural resource sector, low opportunities for livelihood options to mention a few (Stanturf *et al.*, 2011). Studies which reviewed coping strategies developed by the people assert that, popular coping strategies such as charcoal burning and tree cutting which have been adopted

rather destroy the environment and creates further stress upon people's livelihoods as diversification options lie chiefly in the areas of migration, wage labour exchange and the development of on-farm strategies which incorporate climate smart techniques (Yaro *et al.*, 2014; Stanturf *et al.*, 2011). The importance of institutions in promoting adaptation have been recognized in studies undertaken in the northern part of Ghana (For example, Stanturf *et al.*, 2011; Darko and Atazona, 2013; Yaro *et al.*, 2014; Belden, 2010).

Yaro *et al.*, (2014) and Belden (2010) from their investigations found out that, all forms of institutions (formal and informal) are involved in adaptation in northern Ghana. While Yaro *et al.* (2014) posit that formal and informal institutions play complementary roles in adaptation, Belden (2010) discovers that, the relationship and interaction between formal and informal institutions maybe non-interactive, complementary, conflicting or collusive depending on the kinds of resources, incentives and rules in place. These factors may promote or inhibit adaptation and development in a local area (Yaro *et al.*, 2014, Belden, 2010). Institutions involved in adaptation have been recognized to perform specific functions. While state institutions involved in adaptation have with the exception of the Ministry of Agriculture have been identified to offer direct adaptation services (Yaro *et al.*, 2014), NGO's on the other hand have been reported to offer both direct and indirect services to adaptation (*ibid*).

#### **2.2.4 Challenges Smallholder Farmers Face in Accessing Institutional Support**

Smallholder farmers and institutions need to work together to bring about a successful adaptation process. However, it has been realized that, there is sometimes a disconnection between institutions and the smallholder farmers. Studies reviewed around this topic shows that, in most cases smallholder farmers lacked the necessary information to help them cope

with the changes that are being experienced within the sector and especially climate change (Rahman, 2008). This arises from the low numbers of extension officers considering the function they play in the productivity of smallholder farmers. Extension officers introduce new modern farming methods to farmers, better yielding crop and animal varieties and also link farmers to markets and credit. Most smallholders are cut-off from extension support as they are found in areas that are far and difficult to reach. Research has also shown that even when extension support is available, gender, age and status is also a determinant of a farmer being considered for adaptation support (Hassan and Nhemachena, 2008; Deressa *et al.*, 2009). In the bid of institutions aiding individuals and communities adapt successfully to climate change, individuals or communities to benefit from interventions may oppose the adaptation project which might hinder adaptation effort (Jantarassami *et al.*, 2010).

Research conducted on challenges that inhibit smallholder farmers' access to institutional support in Ghana outlined age, wealth, location and gender to be major factors that affected institutional access. Other factors which were less frequently cited in literature as factors which affected smallholder farmer access include weak farm management which is expressed in lack of book keeping and land tenure security.

Yaro *et al.* (2014) and Fosu-Mensah *et al.* (2012) identified finance, limited spacio-temporal reach, lack of human resources and information as issues that challenged the effectiveness of institutional support amongst smallholder farmers. Apart from informational barriers which might result from both institutions and smallholder farmers, all the barriers identified by Yaro *et al.* (2014) and Fosu-Mensah *et al.* (2012) may be described as purely institutional barriers as termed by Moser and Ekstrom (2010).

Bondinuba (2012) acknowledged that another factor that may result in challenges of smallholder farmers accessing support especially from financial institutions is the lack of book keeping by smallholder farmers. This especially creates problems for smallholder farmers when they seek support to adapt from institutions which require collateral agreements as they usually have nothing to show as evidence for their ability to pay back the loans (Sonne, 2010).

The security of the land tenure system being practiced in an area has been identified as another factor which may affect smallholder farmers' decision to access institutional support (Hisali *et al.*, 2010). As land pressure on land continues to rise due to population growth and market development (Cotula and Chauveau, 2007). As a result, smallholder farmers' sharecropping contract with their land owners may be reviewed arbitrarily by land owners for various reasons which eventually leads to their eviction from the land (Du Plessis, 2005; Cotula *et al.*, 2008). This therefore makes it difficult for women and migrant farmers especially who face the worst forms of land tenure agreement to access institutional support to adapt to climate change.

### **2.2.5 Problems Institutions Face in Providing Support to Smallholder Farmers**

Institutions in trying to fulfil their obligations to aid individuals adapt to climate change sometimes face certain challenges. Some of these hindrances might come from two sources: the institutions themselves or from the people whom the institutions seek to help. In this section the discussion is going to be centred on obstacles that arise from the institutions themselves hindering their ability to provide support to farmers.

Various studies looking at institutions in adaptation identified that, the implementation of adaptation projects are affected by hindrances resulting from insufficient finance and staff which in some studies is referred to as resources (Jantarassami *et al.*, 2010; Measham *et al.*, 2011; Deressa *et al.*, 2009; Rajalahti, 2012). This problem usually stems from the fact that, most institutions at the local level depend on institutions at the higher levels and therefore lack the autonomy to make and take decisions without prior approval of their managers (Jantarassami *et al.*, 2010; Measham *et al.*, 2011; Crabbe and Robin, 2006; Mukheibir and Ziervogel, 2007). This institutional barrier tends to affect the quality and scope of adaptation projects as institutions will be forced to offer short-term technical adaptation rather than a long term adaptation approach which will involve integrated approaches with other institutions (Crabbe and Robin, 2006). In a quest to finding a solution to inadequate finance, Rajalahti (2012) suggested that, all stakeholders must contribute effectively with their financial and political capitals to ensure the continuity of adaptation programmes implemented by institutions. However, Spielman *et al.* (2008) submits that, doing this will only go on to further worsen the poverty situation of marginalized households as they have few resources to contribute to the innovation network. Eriksen and Selboe, (2012) demonstrated in their study on how power dimensions at the local level affected policy interventions. They found out that, when formal institutions lead the way in adaptation without giving regard to local institutions, the actors to which adaptation is directed will end up being disempowered thus leading to inaction rather than adaptation (*ibid*).

Insufficient information on the impacts of climate change at the local level has been identified by empirical studies as a barrier that affects the implementation of adaptation projects by institutions at the local level (Crabbe and Robin 2006; Mukheibir and Ziervogel 2007;

Jantarassami *et al.*, 2010; Moser and Ekstrom 2010 and Deressa *et al.*, 2009). This barrier will in most cases result in a partial understanding of climate change impacts on the part of institutions thus, creating uncertainties about the opportunities and benefits that will be accrued to both the institution and society as a result of adaptation (Hummil and Tanner, 2011). This barrier in many instances results from lack of and (or) unavailability of reliable climate information at a scale that is relevant to the local level thus, making adaptation planning difficult (Deressa *et al.*, 2009; Jantarassami *et al.*, 2010).

Another barrier which has been identified to have a great impact on the ability of institutions to offer certain kinds of adaptation support within particular socio-cultural settings is the culture of the people (Moser and Ekstrom, 2010). Empirical evidence from adaptation projects shows that, there have been cases where farmers rejected a particular intervention because it went against their culture (Nielson and Reenberg, 2010).

Pradhan *et al.* (2012) identified that, the involvement of different kinds of institutions in the adaptation process could create a situation where institutions pursue different adaptation strategies that may complement each other or be competitive. This can sometimes make their work in adaptation unsuccessful. Agrawal (2010) also identified that, institutions in the social sphere enjoy a certain level of comparative advantages in their effort to deliver adaptation. Pradhan *et al.* (2012) therefore suggested that, owing to the differences in goals, operation and comparative advantage, the specific roles each institution can play in adaptation must be laid out and the accepted mode of communication and interaction within and between organizations must be clarified). This point is further stressed upon by Agrawal (2010), who also calls for a strict observation of what he calls the three factors in the assessment of institutions in adaptation. These three

factors he mentions to include, the nature and goals of institutions, their methods in facilitating adaptation strategies and the linkages institutions have with each other and the households which they serve. These factors will not only aid in the assessment of adaptation, but also in the process of planning and implementation of adaptation projects. Although these studies support interaction between the different types and levels of institutions, findings of Upton (2005) disclose that, when institutions have weak linkages between themselves, especially those on different levels, partnerships become difficult and tend not to succeed causing the intervention to fail. Agrawal *et al.* (2010) in contributing to this debate, posited that, the responsiveness of local institutions to climate change adaptation is affected by weak technical and managerial skills, poor linkages of local institution with others on the higher levels, poor information gathering and dissemination systems together with unclear missions and conflicting priorities between levels and agencies of government. These constraints have serious implications in the adaptability of the poorest and vulnerable groups who are mostly impacted by climatic stress (Agrawal *et al.*, 2010). This was further illustrated Adger *et al.* (1997) whose study on adaptation in Bangladesh showed that during disasters, when institutional supplies directed at food security, human settlements and health were inadequate to meet the needs of the people, the plight of the people to whom this support is directed tend to be increased. Other scholars such as Smit and Pilfsova, (2007) in their contribution to the institutions and adaptation discourse found that, when institutions are developed and evolved to meet the task of aiding adaptation, they tend to create an enabling environment for the management of trending climate risks. In such a situation,

institutions are equipped to provide the capacity needed to attend to future risks posed by climate change.

### **2.2.6 Improving the linkages between Institutions and Smallholder Farmers**

Empirical studies conducted on the challenges of smallholder farmers accessing institutional support submitted that, barriers to institutional support can be addressed and effectively solved if policy makers and all actors get involved in the process. Daressa *et al.* (2009) argued that, institutional factors that result in low/ no information to smallholder farmers can be addresses through extensive involvement and employment of extension agents in rural areas. This will ensure that, farmers are knowledgeable about the latest techniques of farming and adaptation. Jones and Boyd (2011) in their study argued that, institutions could address social barriers to climate change adaptation by involving the known social networks developed and trusted by the people such as the family and neighbourhood networks upon which members have developed trust.

Further, lack of finance which is identified as one factor that affects smallholder farmer access to institutional support was discussed by Deressa *et al.* (2009) to have the potential to be solved through the creation of local affordable credit schemes which will be easier for farmers to access. Wehbe *et al.* (2008) on the other hand argued that, since farmers had difficulties in financing adaptation, specific public sector organizations could target definite adaptation projects which they would sponsor while offering wages and market access to farmers. This will ensure that smallholder farmers gained access to institutional support while at the same time institutions address the problem of poverty amongst farmers. Howden *et al.* (2007) in contributing to the barriers to adaptation discourse suggested that, the different barriers acting against adaptation can be solved through a

comprehensive and dynamic policy approach involving all stakeholders in the agricultural system. With regards to the socio-cultural system, Jones, (2010) proposes that, institutions offering adaptation support should carry out their interventions in ways that will complement and respects the social and cultural system.

### **2.3 Conceptual Framework**

Since the major objective of this study is to find out the effectiveness of institutions in climate change adaptation, a number of frameworks were analyzed. Based on the goals of this study and the shortcomings identified in earlier frameworks, a new framework was developed. The first framework reviewed is that of Morton (2007) which looks at the impacts of climate change on smallholder farmers. The next framework to be analysed is Moser and Ekstrom (2010) diagnostic framework which seeks to find out the barriers to adaptation. The last but major framework which guided this study is the DFID (2000) Sustainable Livelihood Framework. Grounded on these three frameworks, the study developed a new framework which is modelled on the DFID (2000) Sustainable Livelihood Framework.

#### **2.3.1 Impacts of Climate Change**

Morton's (2007) framework assumes that, the impacts of climate change will be felt differently in all systems and locations. Thus, the impacts of climate change impacts in food production systems may differ (Morton, 2007). The framework also argues that, climate change is not the only stressor acting on smallholder farming as there are non-climatic stressors in the agricultural system which affect vulnerability and must therefore be incorporated into studies (Morton, 2007; Munasinghe, 2001). These non-climatic

stressors, such as poor market access, can also be location specific (Morton, 2007) Stressors on the agricultural system according to Morton, 2007 can be managed by the presence of working institutions as these institutions define the vulnerability or risk of a group of people within a particular setting to climate change. This will then determine the extent of impacts that will be experienced by smallholders. Grounded on this, Morton, 2007 identified two types of impacts on the smallholder farming system, which he classified as agricultural (loss of soil fertility, low rainfall, droughts) and non-agricultural impacts (health, tourism).

This framework proves to be strong as it draws out the differences in vulnerabilities and impacts within and between regions and groups. It makes mention of the different kinds of impacts of climate change that smallholder farmers may experience. It also discusses institutions as having the capacity of affecting the impacts of climate change. However, the main problem with this framework is that, it does not stress on the roles institutions can play in ensuring successful adaptation of smallholder farmers or discuss what makes one institution weak or strong. Again, with regards to measurement of climatic and non-climatic stressors, this study will not lay much emphasis on them as they do not fall within the focus of the study.

### **2.3.2 Barriers to Climate Change Adaptation**

This section discusses the Diagnostic Framework of Moser and Ekstrom (2010) which was propounded to aid in the analysis of barriers in the adaptation process and how attempts can be made at improving access to adaptation. In their work, they identified barriers to be obstacles that can stop, delay or divert the adaptation process. Based on this

definition for barriers, two interrelated categories of barriers to adaptation were identified in literature. These are human and informational barriers and social barriers (Jones, 2010). Human and informational resource based barriers come in the form of knowledge, technological and economic restrictions which may result in spatial and temporal uncertainties in relation to forecast modelling, awareness and information creation to all stakeholders and lack of financial resources to implement adaptation interventions (*ibid*). Social barriers to climate change adaptation result from the psychological, behavioural and socio-institutional features that define human and social reaction in the face of climate change (*ibid*). According to Jones (2010), an important part of this barrier stems from the organization and structure of social institutions. This is because, institutions tend to define the rules of behaviour that govern human behaviour in the form of norms and rules (Ostrom, 2005). This framework proves to be very important to this study because, one of the objectives of the study is to find out factors that hinder both institutions and smallholders from giving and receiving adaptation support. This framework will aid the study to draw a conclusion on how these barriers can be worked upon.

The diagnostic framework assumes that, the process of adaptation undergoes three main phases- understanding, planning and management - each with about three sub-phases (Moser and Ekstrom, 2010). To understand why barriers exist in each phase of adaptation, the framework identifies three interconnected structural elements that influence adaptation and also serve as barriers to adaptation within the socio-cultural setting. These elements are, the actors, the system of concern and the larger context within which they act (*ibid*). This is depicted in Figure 1, arrows show interconnectedness.

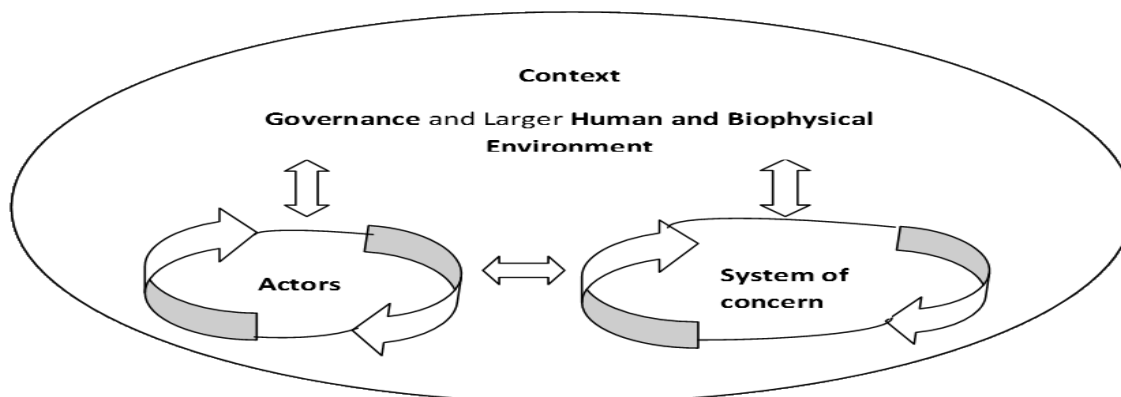


Fig.1 – The diagnostic framework to barriers to climate change. Adapted from Moser and Ekstrom (2010).

The Diagnostic Framework to Barriers of Adaptation undertakes that, the implementation of adaptation projects is undertaken within a system which could be a national, international or local. Within this large system, there are three entities which interact to bring about adaptation or in some cases serve as barriers to the achievement of successful adaptation. The actors within the system include all the individuals, institutions within the system who may be impacted or benefit from climate change. The system of concern here refers to the sector upon which adaptation strategies are being implemented (Moser and Ekstrom, 2010). In the case of this study, the system of concern is smallholder farming. The context of the system refers to the the human and biophysical elements including governance that provide enabling or constraining conditions that shape adaptation actions (*ibid*).

According to the framework, the system of concern may produce signs of changes to the other entities which in the case of this study might be in the form of low yields usually resulting from changes in precipitation and temperature (Lobell *et al.*, 2011). However, whether these signals will be noticed and given proper interpretation by the actors (farmers), governance systems and the larger context depends on the understanding,

planning and management options each entity gives to the signals sent by the system of concern thereby, creating barriers to adaptation (Moser and Ekstrom, 2010).

Since this study is centered on the role of institutions in smallholder adaptaton, the discussion will be focussed on the lower part of the framework which involves actors at the local level. Barrires resulting from the actors may arise when they do not give enough attention to an issue or do not see the need for a feaseable response, adaptation planning and implementation by institutions prove to be difficult to achieve (Moser and Ekstrom, 2010). On the otherhand, when all actors are knowlegeable about the problem and attach importance to it, they will be involved in the whole process and see to its success (*ibid*). The context, in the form of the governance system may also result in some barriers as the political and governance system may also have influence institutions (*ibid*).

### **2.3.3 The Role of Institutions in Achieving a Sustainable Livelihood through Adaptation**

Institutions have been identified to perform functions which structure the nature of impacts of climate change on societies, shape the responses of individuals and also influence external interventions address to specific problems created by climate change within a particular society (Agrawal, 2010; Agrawal and Perrin 2008). This is because, climate change has been identified to affect the natural resource sector with agriculture being one of the sub-sectors being most at risk (IPCC, 2013), efforts to address adaptation must find a way of ensuring that the livelihoods of people engaged in the agricultural sector is viable while at the same time ensuring food security goals and controlling climate change (Beddington *et al.*, 2012).

The next framework reviewed to achieve the purpose of this study is the DFID (2000) Sustainable Livelihood Framework. This framework initially was developed by the Institute of Development Studies (IDS), UK and improved upon by the UK's Department for International Development (DFID).

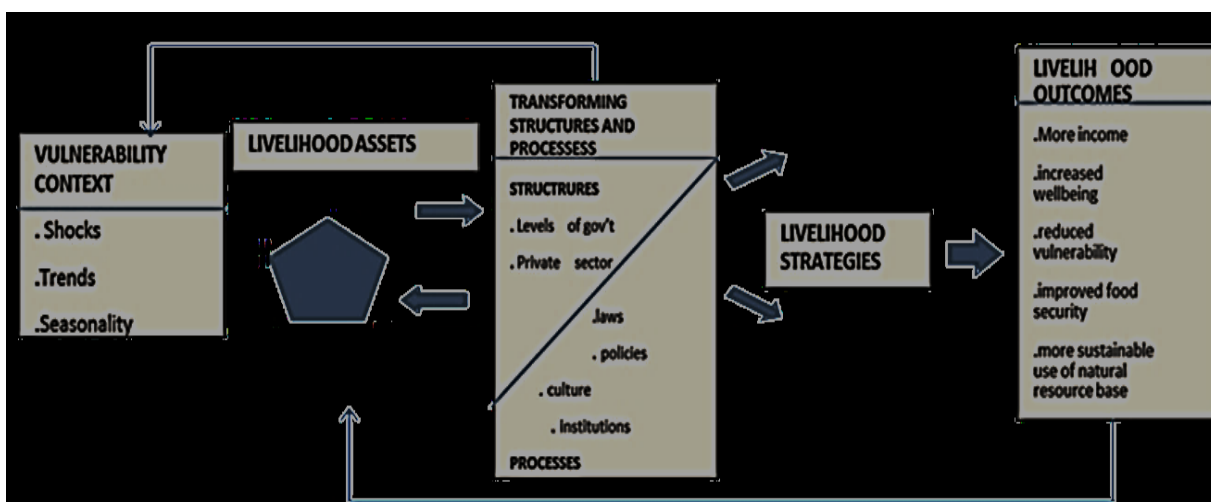


Fig.2- DFID's Sustainable Livelihoods Framework (2000)

It was created to aid in the analysis of poverty and the livelihoods of the poor in rural areas, has proved itself indispensable to the analysis of other issues including climate change adaptation (M'Cormack, 2011). Due to its flexibility, other organizations such as the UNDP, CARE and OXFAM have modelled it to suit the aims of their work.

The DFID (2000) framework as shown in Fig.2 assumes that, human societies are made up of five interconnected elements. These are the vulnerability context, livelihood assets, transforming structures and processes, livelihood strategies and livelihood outcomes. The vulnerability context refers to the external environment in which people exist, over which they have no control (Scoones, 2009) but which influences their assets and livelihoods (ATPHA, 2014). According to the DFID framework, the vulnerability context can be

defined by its shocks, trends and seasonality (Fig.2). Shocks in this case refer to anything that could put a society into disequilibrium. These could be environmental or conflict-related. Trends denote resources and technology while seasonality refers to economic indices such as price changes and employment opportunities (*ibid*). There is little influence individuals can have on the vulnerability context however, institutions can affect it (*ibid*). This is shown by the arrow from the transforming structures and processes to the vulnerability context in Fig.2.

The quantity and combination of livelihood assets individuals and households in the society can acquire empowers them to influence and gain access to the institutions whose possesses and structures affect their lives (ATPHA, 2014). Livelihood assets in the framework refer to the tangible and intangible resources available to the individual which form his/her capital base (Scoones, 2009). The framework identifies five livelihood assets a household has. These are the natural (made up of natural resources and environmental services), human (skills, knowledge, labour), financial (cash, savings, credit), social (networks) and physical which is made up of infrastructure, tools and equipment for production (ATPHA, 2014; Scoones, 2009). Transforming structures in the framework denotes institutions that exist within the society and influence human behaviour through processes such as the establishment of laws, polices and norms. The processes and structure of institutions affects people's ability to pursue different actions that will result in their livelihood strategies, goals or out comes (Scoones, 2009) as shown in Fig. 2.

The fundamental part of this framework according to Scoones (2009) is the transforming structures and processes (institutions) as they influence sustainable livelihood outcomes. Scoones (2009) therefore, proposed the analysis of each element in the framework with

an institutional lens by identifying the institutional matrix that determines the major trade-offs between the various elements of the framework. In order to reach this aim, Scoones (2009) further argued for, a hybrid methodological technique to be used in answering questions related to each element of the framework. The hybrid methodological approach he proposed is a mixture of qualitative, survey techniques and rural appraisal techniques. Results from this method can be used in participatory planning involving all stakeholders (*ibid*).

Although the DFID (2000) sustainable livelihood framework has much strength, it is widely criticized for taking an economic lens to addressing vulnerability. This flaw is however, downplayed by Scoones (2009), who in his effort to analyse the framework advocated that, each element of the framework could be analysed by taking an evaluation of how institutional arrangements affect them.

This framework directly relates with this study as all of its components falls within the confines of this study. The framework suggests a rural community in which the natural resource sector serves as the major livelihood option for the people. This is relays well with the chosen study areas. It assumes that, institutions are independent organisms within the society and their activities influence that of the individuals through their relationships with their assets and livelihood goals. However, the main problem with this framework is that, it did not take into consideration the challenges institutions face in aiding individuals and communities adapt to climate change. Thus guided by the tenets of this frame work, the study borrowed aspects of Moser and Ekstrom (2010) Diagnostic Framework and Morton (2007) Framework on climate change impacts to develop a new framework that will guide this study as shown in Fig 3.

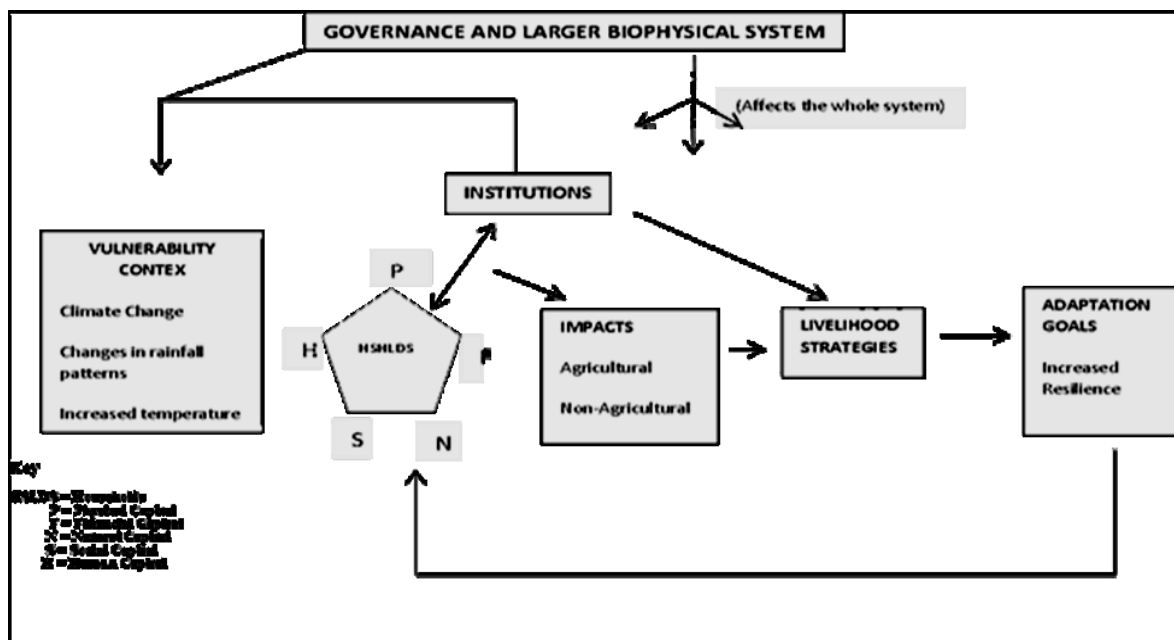


Fig. 3: The modified framework to guide the study. Based on DFID (2000), Morton (2007) and Moser and Ekstrom (2010). (Source: Author's construct)

The modified conceptual framework assumes that, the whole system is vulnerable to climate change which in this study measured by changes in temperature and rainfall (Lobell *et al.*, 2011). It also assumes that, within the system there are entities at the higher level which have been designated as governance (Moser and Ekstrom, 2010). Governance in this sense represents institutions and organizations at the global and national levels levels such as the UN, regional groupings and state governments. These entities usually have their representatives at the local levels who interact with the local actors in development which in this framework is labelled 'Institutions'. Local institutions and sometimes together with international and national bodies identify the impacts of climate change on households and individuals within the social system in which they operate (Agrawal, 2010; Agrawal and Perrin, 2008). By doing this, both institutions at the local level and their partners on the higher governance level, find out the adaptation needs of the people and develop ways to helping them address the challenge (Agrawal, 2010; Agrawal and Perrin, 2008). From the conceptual framework, the

relationship between institutions at the local level and their partners at the governance level might affect adaptation, resulting in barriers as identified by Moser and Ekstrom (2010). The strategies which they develop to aid individuals adapt to climate change is denoted by 'Livelihood Strategies in the framework. However, wheather households, which lie at the lowest part of the system will be highly impacted by climate change depends on their rate of access to institutions (DFID, 2000). From the diagram (Fig.3), when institutions and households are in easy access to each other, the impacts of climate change will be easily recognised and attended to. Thus, influencing the livelihood strategies of individuals leading them to achieve an increased resilience to climate change as is shown in Fig.3.

#### **2.4 Summary of chapter**

The discussion begun by reviewing a set of literature that have studied the impacts of climate change on smallholder farming. These set of studies found that, climate change brings about changes in rainfall and temperature which has consequences on food security and poverty of smallholder farmers (Morton, 2007; Ngigi, 2009; Cooper *et al.*, 2008; Rahman, 2008; Morton, 2007; Collier and Dercon, 2009; IPCC, 2013). Adaptation which is the best response to climate change by smallholder farmers has been identified to need institutional involvement as smallholder farmers lack the requisite technology, finance and information to ensure successful adaptation (Ellis, 2000; Agrawal, 2010; Smit and Pilfisoova, 2007; Penalba, 2012; IPCC, 2013; O'Riordan and Jordan, 1999; Penalba *et al.*, 2012; Moser and Ekstrom 2009; Tompkins *et al.*, 2010; Ziervogel and Ericksen, 2010 and Pradhan *et al.*, 2012).

The review also indicated that, there were barriers to adaptation that arose from both institutions and smallholder farmers. Prominent causes of institutional barriers to the provision of adaptation support in literature include insufficient information on the impacts of climate change at the local level and uncertainty about the opportunities created by climate adaptation (Crabbe and Robin, 2006; Mukheibir and Ziervogel, 2007; Jantarassami *et al.*, 2010; Moser and Ekstrom, 2010 and Deressa *et al.* 2009; Fosu-Mensah *et al.*, 2012). The lack of (or) insufficient finance and human resources to institutions were also identified to affect the quality of institutional support (Jantarassami *et al.*, 2010 Measham *et al.*, 2011). Moser and Ekstrom (2010) and Nielson and Reenberg (2010) argued that, environmental factors such as the socio-cultural setting of the target of adaptation also affected the success of institutional support. While Jantarassami *et al.* (2010) contend that, smallholder farmers also create certain difficulties that affect their adaptability such as not showing interest in the the adaptation intervention introduced by institutions.

Studies reviewed on climate change and small holder farming in Ghana attests to the findings on the international level of the evidence of climate change impacts on smallholder farmers (Kusakari *et al.*, 2014). Although Ghanaian farmers have developed some form of adaptation strategies, a large proportion of farmers have been identified to have not adapted successfully due to poverty and lack of information on the weather and adaptation strategies (Stanturf *et al.*, 2011; Fosu-Mensah *et al.*, 2012). It is recognised that, the activities of and presence of institutions in the three northern regions is high due to the lack of developmental opportunities as compared to southern Ghana (Santurf *et al.*, 2011). Despite the large presence of NGO's and other developmental agencies'

involvement in climate change adaptation in northern Ghana, studies to assess the effectiveness of institutional support is yet to be explored. Though Yaro *et al.* (2014), set out to measure the functions institutions play in adaptation, they posit that, the success of institutional support in northern Ghana is weak due to the large socio-temporal coverage areas of institutions together with lack of finance and human resources affects. Additionally, studies on climate change adaptation in northern Ghana are centred on cases involving the Northern Region and Upper East Region. This study will however, be conducted in the Upper West Region. This study will therefore find out whether the same applies in the Sissala East and West Districts of Ghana.

To conclude the discussion, research methods applied by most of the studies reviewed on institutions and adaptation employed the use of the hybrid methodology proposed by Scoones (2009) in the conceptual frame work. These included methods included combinations of the following, administration of questionnaires, focus group discussions, key informant interviews observation, rural appraisal and participatory methods of data collection and application of qualitative and quantitative methods in their data analysis (Measham *et al.*, 2011; Magombo *et al.*, 2012; Moser and Satterthwaite, 2010; Kusakari *et al.*, 2014; Ngigi *et al.*, 2009; Eriksen and Selboe, 2012 and Bondinuba 2012).

## CHAPTER THREE

### METHODOLOGY

#### 3.1 Chapter Outline

This chapter discusses the research methods used in undertaking the study. It begins by identifying the appropriate research paradigm and explaining the methods employed in the study. The section is followed by discussing the study area, units of analysis and data sources among others. The chapter ends with a brief summary.

#### 3.2 Research Paradigm

The underlying assumptions and structure upon which this study is based is the pragmatic worldview. This research paradigm was used because it allows the study to focus on the research problem by ensuring the use of mixed methods to reach a solution to the problem as advocated by Scoones (2009) in the conceptual framework. Furthermore, since this study sought to find out what (effect of institutional support; challenges institutions and smallholder farmers face in adaptation) and how (linkages between institutions and smallholders can be strengthened to ensure successful adaptation) of institutions in adaptation amongst smallholder farmers using the mixed method of enquiry helped the study achieve its purpose. The mixed method of research enquiry has been incorporated into many studies and their findings have so far proved to be valid and accurate (Amaratunga *et al.*, 2012).

### **3.3 Research Methods**

The study applied a mixed methods approach to investigate the effectiveness of institutional support to climate change adaptation amongst smallholder farmers. The study employed the use of both qualitative and quantitative methods in order to ensure the validity of results the research produce as propelled by Mathison (1988). The study took the form of a concurrent mixed method where both qualitative and quantitative data was collected simultaneously and the results integrated during data analysis. This is evidenced in the use of both close ended and open ended questions in the questionnaire and during the act of collecting data, where institutional interviews and administration of questionnaires were conducted simultaneously. Both the qualitative and quantitative methods were very important to the study as the qualitative research method as either method strengthens the other's weakness. The qualitative method for example gave the study the opportunity to have a detailed study of institutions involved in the study. This is seen in the chance institutional representatives had in freely discussing their organizations' adaptation activities. Additionally, the application of the qualitative method allowed for immediate clarification of issues which would have been difficult in a purely quantitative study. The quantitative method of enquiry on the other hand allowed the study to employ the use of statistical methods in data analysis which gave the study the opportunity to successfully measure the effectiveness of institutional support.

### **3.4 The Study Districts**

The study areas for this study were the Sissala East and West Districts. These are two adjoining districts in the Upper West region of Ghana as shown in the map of the study area (Appendix 3). They were selected because, they share similarities in terms of

climate, socio-economic characteristics, culture to mention a few. The Sissala East District was selected because, it was included in the Africa Adaptation Project conducted nation-wide in 2012 as one of the five pilot districts, which had livelihood diversification as its focus. The Sissala West district was chosen mainly because of its proximity to the Sissala East District in terms of distance and transportation costs. Though other districts surround the Sissala East District, the transportation networks are irregular thus increasing costs by travelling on either a motor or a vehicle. Again, the Sissala West District had no known targeted adaptation programme implemented there.

### **3.4.1 The Sissala East District**

The Sissala East District is located between longitudes 1°30'W and 2°40'W and latitudes 10°00'N and 11°00'N (MoFA, 2013a). It shares common borders with Burkina Faso to the north and the Sissala West District to its west. To its east are the Kassena-Nankana and Builsa districts in the Upper East Region. The Sissala East District shares boundary at the south-eastern portion with West Mamprusi District of the Northern Region (Ministry of Local Government and Rural Development and Moks Publications and Media Service, 2006b).

The total population of the Sissala East District is projected to be 56,528 made up of 27,503 males and 29,025 females including children (GSS, 2012). The district is mainly rural with more than 80% of the people living in rural settlements dispersed in space within the district (MoFA, 2013a). From the 2010 census figures there are 8,570 households living in 5852 houses in the district. The major economic activity of the people is agriculture, which employs about 76% (16,279 people) of the total working population. The service and commercial sector employs an estimated 12% while the

industrial sector employs the least with an expected 9% of the districts total work force (Ministry of Local Government and Rural Development and Moks Publications and Media Service, 2006b).

Farmers in the district usually engage in both crop production and animal husbandry (MoFA, 2013a). Farmers go into animal rearing as a form of diversification for supplementary income and for household nutrition needs (*ibid*). Major crops farmed in the area include maize, soya beans, groundnuts, yam, rice, cowpea, cassava and cotton (*ibid*). Animals kept by farmers include cattle, sheep, goats, pigs and poultry (*ibid*).

The topography of the Sissala East District is gently undulating. Towards the northern part of the district, the land rises to heights between 330 and 365m above sea level (here after asl) and descends to about 220m (asl) and 290m (asl) in the Valley of the Sissili River (Ministry of Local Government and Rural Development and Moks Publications and Media Service, 2006b). The major river in the district is the Sissili River, which flows in a south-eastern direction, together with its tributaries to join the White Volta drainage system (Ministry of Local Government and Rural Development and Moks Publications and Media Service, 2006b). The soil type in the district is mainly savannah ochrosols and tropical brown earths. These soils are better suited for the cultivation of cereals and root tuber and cotton (MoFA, 2013a).

The district falls within the Tropical continental Zone of Ghana thus, experiences a long dry season followed by a short rainfall season which begins in May and lasts till September/October (Ministry of Local Government and Rural Development and Moks Publications and Media Service, 2006b). High temperatures are experienced most times

of the year with the mean monthly temperature ranging between 21°C and 32°C, highest temperatures are recorded just before the onset of the rains with temperatures rising to about 40°C (*ibid*). The vegetation of the Sissala East District is Guinea Savannah, which is characterized by grasses, scattered trees and shrubs such as baobab, dawadawa, sheanut and neem (*ibid*).

### **3.4.2 The Sissala West District**

The Sissala West District which is located between latitudes 10°00'N and 11°00'N and longitude 2°13'W and 2°36'W (MoFA, 2013b). The district shares boundaries with Burkina Faso on the north, Sissala East District on the east, Wa East is to the south, Jirapa and Lambussie-Karni Districts are to the west and Daffiama Bussie is to the south west. Its capital is Gwollu (Ministry of Local Government and Rural Development and Moks Publications and Media Service, 2006a).

The district has an estimated population of 49,573 people which comprise 24,151 males and 25,244 females residing in 7,116 household (GSS, 2012). The major economic activity of the people is agriculture, which employs 80% of the districts labour force (Ministry of Local Government and Rural Development and Moks Publications and Media Service, 2006a). Farmers in the district engage in both crop production and animal husbandry as a form of diversification (MoFA, 2013b). Major crops farmed in the district include maize, soya beans, groundnuts, yam, rice, cowpea and cotton (MoFA, 2013b)

The Sissala West District falls within the tropical continental climate just like the Sissala East District. Therefore, it experiences a long dry season (November- April) followed by a single maxima rainfall season (May-September) ( Ministry of Local Government and Rural Development and Moks Publications and Media Service, 2006a). The temperature

of the district is high most times of the year with the mean monthly temperature ranging between 21°C and 32°C ( *ibid*). Highest temperatures are recorded just before the onset of the rains with temperatures rising to about 40C ( *ibid*). The vegetation of the study areas is Guinea Savannah, which is characterized by grasses, scattered trees and shrubs such as baobab, dawadawa, sheanut and neem ( *ibid*).

The land in the Sissala West District rises from about 150m (asl) at the lowest points to 600m (asl) (MoFA, 2013b). The major river of the district is the Kulpawn River and its tributaries, which flow in a dendritic pattern ( *ibid*). The type of soils in the district is savannah ochrosols and tropical brown earths which support the cultivation of cereals and root tuber and cotton ( *ibid*).

### **3.5 Unit of Analysis**

The units of analysis of this study were farm households and institutions involved in agricultural development in the study districts. Institutions in the district such as the District Assembly (DA), the District Agricultural Development Unit (DADU/MoFA) and NGO's that target farmers were included in the study. Initially from the research proposal, banks operating in the district were targeted for the study. However, from the field visit, it was realized that financial institutions in the district (Ghana Commercial Bank, Agricultural Development Bank and the Sissala Rural Bank and Co-operative union) provided strictly banking services and do not really target farmers neither do they have any special programmes running to help them to cope or adapt to the changing climatic patterns.

Farming households were included in the study since their adaptation is the main focus of the study. Again, farming households were identified rather than individual farmers to reduce duplication of responses as most people within the study areas farm with members of their households as a collective group. This made the study more representative as responses reflected the ideas and experiences of a wider range of people within a shorter time-frame and on a lower budget than would have been the case if individual farmers were contacted. The District Assemblies (DAs) of the two districts were identified for the study because the district assembly is the local representative of the central government in the district. The assembly also determines the rate and pace of development, allocates resources to ensure economic and social growth of the district. Individuals in the DAs who were interviewed are, the district planning officers and the director of the District Agricultural Development Unit (here after DADU/MoFA). The district planning officers in both districts were identified because, they serve as secretaries to the district planning coordinating unit. Therefore per their position, they are aware of all projects and programmes running within the district to aid them in decision making. The director of the DADU/MoFA in both districts were included in the study because, their unit holds the districts agricultural information and liaises between the district and regional Agricultural officers. In the Sissala West district, the Director of the DADU/MoFA provided all the relevant information needed for the study. In the Sissala East District on the other hand, the officer responsible for the environment and the officer in-charge of extension services were authorized by their director to offer information to assist the study. Directors of NGO's involved in agricultural services were also consulted to aid the study considering the support they give to smallholders in acceptance of innovations and

technology. This group of respondents discussed the aid their institutions give to farmers to help them adapt, their sources of funding, and whether their interventions were being accepted by the local farmers. NGO's which were included in the study were Tumu Deanery Development (here after, TUDRIDEP) and Sissala Literacy Development (here after, SILDEP) and Action for Sustainable Development (here after, ASUDEV). A private service provider to farmers- Masara N'Aziki Association- was also included in the study as they supply inputs in the form of improved seeds, fertilizers and other chemicals to farmers at a subsidized rate. All of these institutions operate within the two districts.

### **3.5.1 Sources of Data**

This study employed both primary and secondary data. Primary data was collected from farmers, district planning officers, heads of NGO's and extension officers (agricultural development unit). Data from these sources were solicited through answering of questionnaires and semi-structured interviews. Questionnaires were administered to household heads who were involved in farming. Questionnaires were administered to farmers in most cases at their homes early in the morning before they left for their farms or late afternoon when they returned from their farms. Interviews with institutions were organized at the offices of the institutions within working hours.

Secondary data were collected from both electronic and non-electronic sources including books, journals, conference proceedings, reports and webpages. Data from these sources guided the research on issues relating to data collection methods, sampling and how to go about the study. They also guided the study in relating its findings to what has been done

before so as to strengthen the findings of earlier studies, bridge the gaps found in earlier studies and to add up new findings to the subject area. Observed rainfall and temperature records in the district over the past 50 years (1960-2010) was collected from the Meteorological Agency, Accra. However, there were many missing data which could affect analysis therefore, temperature and rainfall records for Wa which also falls within the same agro-ecological zone but has less missing data was collected. Maps of the districts were also requested from the Department of Geography and Resource Development, University of Ghana, Legon.

### **3.5.2 Target Population**

This study was directed at smallholder farmers in the Sissala East and West Districts and institutions that offer adaptation support to them. However, reference to smallholder farmers is directed at households rather than individual farmers. This is because, smallholder farmers have been identified to work together with members of their households (Ellis, 1998). Thus, to reduce repetition, the study sought to sample households. According to the 2010 population census, the Sissala West District has about 7,116 households which are mainly agrarian (MoFA, 2013b) whilst the Sissala East district records about 8,652 households also mainly agrarian (MoFA, 2013a). Based on this information, the study took a sample of 160 farming households – 80 from the Sissala East District and 80 from the Sissala West District. The sample size of the institutional survey was one individual per an institution.

### 3.5.3 Sampling Techniques

To make the sample size representative of the farmer households in each of the districts, a proportion of the total sample was allocated to both districts (50%). Population within both districts are wide apart, dispersed and weakly connected by transportation networks especially during the rainy season, when this study was undertaken. The study therefore targeted communities in the two districts which possessed the following characteristics – high farmer population and easy accessibility by distance and by road condition in the rainy season. These selection criteria was followed to allow the study to reach as many farmers as possible within a day as the period during which the study was undertaken fell within the planting season. As such, farmers could only avail themselves either early in the morning or late afternoon to evening when they close farm activities or half day on Fridays and Saturdays. Based on this this information the study randomly selected the following towns to be involved in the household sample. Tumu, Taffiasi, Tarsaw, Wellembelle and Kunchorkor all in the Sissala East District and Gwollu, Silbelle, Kong, Nankpawie, Lilixie and Jeffisi in the Sissala West District were selected for the study (refer to Map). Samples drawn from each community was based on based on the number of farm households that were available in town during the time of data collection as some households tend to reside on their farms during the planting season. Households included in the study for each community was selected using a simple random format. In the end the sample collected for each town involved in the study is recorded as follows: Tumu (10), Taffiasi (16), Wellembelle (25), Kunchorkor (13), and Tarsaw (16) all in the Sissalla East District; Gwollu(13), Silbelle(13), Kong (12); Nankpawie (13), Lilixie (5) and Jefissi (18) bringing the total sample to 160.

The institutional survey initially took on a purposive direction as initial institutions identified (district assembly and some NGO's) were approached because of the roles they were known to have been playing already within the district. However, as the fieldwork proceeded, the sample moved into the stage where institutions recommend others within the districts who are also involved in offering adaptation support to smallholders. This therefore brought the sample size for the institutional survey to a total of 12 from the two districts. The institutions surveyed were the district assemblies of both districts (represented by the district planners- 4), the District Agricultural Development Unit (represented by the director in the Sissala West District and for the Sissala East District by the Environmental desk officer with assistance from the Extension services desk officer), the three NGO's (SILDEP, TUDRIDEP and ASUDEV) and Masara N' Aziki all of which operate in the two districts with their head offices in the Sissala East District. The NGO's were represented by their Directors while Masara N'Arziki was represented by the agronomist with assistance from the accountant.

The institutional survey followed a non-probability format. Institutions were purposively selected based on their involvement in agricultural development in the districts. Following the snowball technique, the initial institutions contacted for the study were asked to recommend other institutions within the districts that are involved in offering adaptation support to farmers in the district. This format was followed until all institutions involved in offering institutional support to smallholder farmers were covered.

#### **3.5.4 Data collection instruments and procedures**

The tools used in data collection included questionnaires, structured interviews, and analysis of documents. The questionnaires were made up of about 30 questions formed by the researcher. The questions consisted both closed-ended and open-ended questions. The questions sought answers to questions such as farmer perception on climate change and their access to institutional support on adaptation.

With regards to the institutions, questions were mainly directed at finding answers to weather institutions offered assistance to farmers to help them in adaptation and what form of support is given. The questions also sought to find answers to the problems institutions faced in providing support to smallholder farmers in the district and at what extent do these problems arise from the institutions or from the smallholder farmers themselves.

Rainfall and temperature data on the district over the past 40 years was acquired from the Ghana Meteorological Agency to enable the study corroborate farmer perception on climate change to scientific records.

Data for this research was collected using survey questionnaire, structured interview and content analysis. Participation in the study was voluntary, as the consent of respondents was sought from individuals and institutions before they were included in the study. Questionnaires were administered to selected smallholder farmers on their farms and in their homes. In cases where farmer was could not read or write, the questionnaire was administered in the form of a structured interview with the aid of an interpreter. Most of the questionnaires were completed within 15 minutes since farmers in discussing their

answer to a particular question, provide pointers to other questions which will be asked later. This made it possible for about 15 questionnaires to be administered when farmers were available.

Institutional interviews were conducted with representatives of the selected institutions either during break times on their official timetable or at an appointed time pre-arranged with them. To save time in writing, the permission of participants were sought to enable recording of the interview.

### **3.6 Data Management and Procedures of Analysis**

This section discusses the regulatory practices regarding the handling of information received in relation to this study. The section begins by describing how the data from the field survey was handled and ends with some ethical issues that were considered during the conduct of the study.

#### **3.6.1 Data Editing**

Data from the field was edited to ensure that, respondents who filled in the questionnaire unaided had answered all questions. This was done on the spot so as to draw the attention of the respondent to give his/her opinion on the issues in the questionnaire. This is because, partially filled questionnaires do not present the full story of the respondent and therefore accurate analysis cannot be drawn on them. Data editing with the institutional interviews was also done on the spot. As recording of the interview was done in writing, the interviewer could ask the interviewee to clarify statements which were not clearly heard or understood.

### 3.6.2 Technique of data analysis

Filled questionnaires from the field were encoded with numbers starting with 001. Questions and answer choices were coded into the computer to aid analysis. The software packages that were used in analysing the data are the Statistical Package for the Social Sciences (SPSS) version 20. With the coded questionnaires, analytical methods were used from the SPSS package. Apart from the researcher being conversant with SPSS, other similar studies had used SPSS as the tool for data analysis and their results have been accurate. The climatic data was analysed by use of MS Excel (2010). Computer tools for data analysis in both statistical programmes such as the chi-square tests, ANOVA, frequencies, mean and percentages were employed.

The null hypothesis was tested using the chi-square test of independence. This is because, this statistical test best determines the association between the distribution of responses to the outcomes across two or more independent samples. The chi-squared test was also performed to find out whether there was any relationship between age and gender to access to institutional support.

The chi-square test was conducted using the formula,

$$X^2 = \sum \frac{(o - e)^2}{e}$$

Where,  $X^2$  = chi- square test

$\Sigma$  = the summation

o = observed frequencies

$e$  = expected frequencies

The climatic data was subjected to both  $t$ -test and  $f$ -test. These tests were performed after the rainfall records of the study area had been divided into two groups. These are, Period 1 (P1) spanning 1960-1985 and Period 2 (P2) which begins from 1986-2011.

The  $t$ -test was done to help the study determine whether there was any statistical difference between the recorded rainfall and temperature between the two periods. The  $t$ -test was tested against the null hypothesis that, there is no statistically significant difference in the rainfall or temperature within P1 and P2. The  $t$ -test was done using the formula,

$$t = \frac{\bar{X}_T - \bar{X}_C}{\sqrt{\frac{\text{var}_T}{n_T} + \frac{\text{var}_C}{n_C}}}$$

Where,  $\bar{X}_T$  = mean of P1

$\bar{X}_C$  = mean of P2

$\text{var}_T$  = variance of P1

$\text{var}_C$  = variance of P2

$n_t$  = number of values of P1

$n_c$  = number of values of P2

The  $f$ -test was performed to test the variance of rainfall records taken from the two districts. The  $F$ -statistic was performed under the null hypothesis that, there have been no

changes experienced in the rainfall pattern experience in the district over the past 50 years. F- test was tested using the formula,

$$\sigma^2 = \frac{\sum (X - \bar{X})^2}{n - 1}$$

$$\text{F value} = \frac{\sigma_1^2}{\sigma_2^2}$$

Where,  $\sigma^2$  = variance

$\Sigma$  = summation of values

$X$  = values in a given data set

$\bar{X}$  = mean value of the data

$n$  = total number of values

### 3.6.3 Ethical Issues

Ethical issues were considered during the whole of the study. Information sources were given due recognition at each stage of the study. During the problem statement, the researcher had to ensure that the confines of the study will not only aid in acquiring a degree, but also bring out meaningful results that will be of immense benefit to farmers and policy makers in the study area and Ghana as a whole.

During the data collection stage, respondents were required to give their consent to participate in the study. They were also informed of the purpose of the study as were outlined in Chapter 1 before they were included in the study. In few cases, the consent of

husbands/ caretakers (when data was being collected from women household heads) had to be sought before they were allowed to be involved in the study. This was as a result of the cultural practices of the people. In all the cases, men whose consent was sought gave their agreement for the questionnaire to be administered after the researcher explained the reason for the study to them. Perhaps the men allowed the researcher to speak to their female relations because she is also a female. With the households consent was mainly verbal though there was a line informing respondents of their safety and confidentiality written on the first page of the questionnaire. Introductory and request letters were sent to institutional heads. The letter stated the identity of the researcher, the purpose of the study and the process for the selection of participants for the study. The letter and consent statements also assured participants of having the freedom to decide on participating or withdrawing at any stage of the interview.

During the stage of data analysis, the identities of respondents were protected by identifying them by their coded numbers as names were not collected to protect their identity. The names of institutions involved in the survey were identified, however, the name of the representative was not mentioned to protect their identities and job security. However, their positions have however been adopted in the discussion to make the narrative flow.

### **3.7 Limitations of the Study**

The first limitation encountered was the need to change the study area. The districts initially selected for this study were the Sissala East and Wa East Districts in the Upper West Regions. However, when the field work was being undertaken, it was realized that the Wa East District is rather isolated in terms of transport connectivity both within the

district and from neighbouring districts. Therefore the study chose to undertake the study in a district which is closer to Sissala East District in order to save cost and time.

The study also faced challenges with respect to transportation. This resulted from the fact that, transport networks within the two districts were poorly developed. Movement by public transportation (urban buses /trotro) between the districts was irregular as they were available only on market days and at specific times of the day. Although motor cycles were available, they were mostly privately used by the owners and not run as a motor cab (okada). This made travelling without a means of transport time consuming as one would have to wait at the road for long time, hoping to come across a motor rider who was plying the same route or going to the same destination. This was overcome by hiring a motor and fuelling it each day the field was visited.

Apart from this, reaching the farmers during the on-farm season was difficult as farmers were busy. The research therefore took the strategy of meeting farmers very early in the morning before they left for their farms or late afternoon when they return home. Some of the respondents approached were fatigued from being called upon to fill out questionnaires or forms as they put it without seeing any significant difference in their lives and some therefore asked to be paid before they gave information or in some cases gave outright refusal to answer the questionnaire. This problem was overcome by assuring prospective respondents that, this was mainly an academic work and that if they gave the true picture of what was occurring, they might receive some form of support from institutions which will come across the study.

With the institutional survey, there were no peculiar challenges as interview times were pre-scheduled and in other cases, the interviews were carried out on the same day as the researcher approached them once the appointed officer for the interview was available.

### **3.8 Summary**

This chapter described the methods used in data collection and analysis of this study. The study districts were discussed together with the units of analysis which were considered study. Within this chapter, the sample size and sampling techniques were described. Ethical issues that were observed throughout the study were also discussed. In order to make the results of this study accurate and valid, the study ensured that all the processes described in the sampling and data analysis stages were observed.

## CHAPTER 4

### DATA ANALYSIS

#### 4.1 Chapter Outline

This chapter presents the results of analysis conducted on all data received for the study. Quantitative data from the field was analysed by the use of Statistical Software Package for the Social Sciences (SPSS) version 20. Climate data on the study areas was analysed with Microsoft Excel (2010). Functions within these statistical packages that were employed for the analysis include parametric and non-parametric tests such as the Chi-square test, f-test, averages, cross-tabulation, frequencies and percentages. The chi-square test was performed on the field data to find out whether there was a significant difference between farmers who have access to institutional support and those who did not. The f-test was performed on the climate data to test for variations in the climatic data. Data is presented in textual and graphical formats.

Content analysis of qualitative data was undertaken to ascertain the validity of information received. Excerpts of interviews are reported in the discussion to relate the views of farmers to that of the institutions and vice versa. Data was analysed and presented in themes following the research objectives. The sample size for the household survey was 160 while the institutional sample size was 12.

#### 4.2 Bio-Data of Respondents

A total of 160 people were sampled for the study in the Sissala East District (hereafter, SED) and the Sissala West District (hereafter, SWD). The selection of the sample was

equally distributed between the two districts. Approximately 50% of the total sample representing 80 people was selected from either district. The age, sex and education level distributions of the sample was conducted and discussed in the subsequent paragraphs.

Analysis of respondents' age's shows that, the mean age bracket of respondents in the study is 40-59. This age bracket made up 52% represented by 83 household heads involved in the survey. About 39% (63) of the total sample fall within 18-39 years. Respondents involved in the study who were above 60 were the least represented as they make up about 9% (14) of the study.

Furthermore, results of data analysis showed that, more men than women were involved in the study. Men made up 63% (100) of the total sample whilst women made up 37% (60) of the study. An investigation into the location of respondents by their genders showed that, more women were involved in the Sissala East District than the Sissala West District. Women in the Sissala East District made up about 21% of the total sample whilst women in the Sissala West District made up about 16% of the total sample. These were represented by 33 and 26 women in both locations respectively. Men in the Sissala East District made up about 29% (47) of the total sample while men in the Sissala West District represented about 34% (54).

Additionally results of the data analysis showed that, all the stages of the educational ladder were represented in the sample. However, a large proportion of the sample, representing by 75% (160) of respondents was informally educated. The rest which is made up of 25% of the total sample had been educated to some stages of the educational ladder. Out of this proportion, 9% (15) had received primary education, 4% (7) had had

JHS education and 9% (15) had received SHS education while 2% (3) of the sample stated that they had acquired tertiary education.

### 4.3 Institutions Operating in the Districts

Table 1 show a classification of institutions in operation in the study districts. Interviews conducted with representatives of institutions inferred that, there were three main types of institutions in operation in the districts. These are public, private and a private institution that runs as a civic or membership organization. As indicated on the table, the two district assemblies and the District Agricultural development units (here after DADU/MoFA) – the district unit of the Ministry of Agriculture (MoFA)- in the two districts are purely public institutions. All the NGO’s are privately owned but have non-profit goals.

Table 1 - Classification of institutions involved in adaptation in the study area

Public Institution	Private Non-Profit Organization	Civic (Membership) Organizations/ Groups	Private (for-profit) Institution
Sissala East District Assembly	SILDEP	Masara	N’ Aziki
Sissala West District Assembly	TUDRIDEP		
DADU/MoFA (Sissala East and West Districts)	ASUDEV		

Source: Field Survey, 2014.

#### 4.3.1 Activities of the institutions in the study districts

Analysis on the operations of the institutions working in the two districts showed that, apart from the Public organizations which have offices that serve people in the respective districts where they operate independently of staff and offices, all the private institutions have their main offices in the Sissala East District and the same set of staff attend to farmers in both districts. In terms of hierarchy and interaction, as the IPCC (2013) posits,

each of the institutions interact horizontally with other institutions involved in climate change activities in the districts. This was done through direct engagement they had with each other during annual meetings organized by the district assemblies for NGO's and other institutions in operation within the districts where institutions lay out their plans as to how livelihoods in the district might be improved.

Furthermore, analysis on vertical relationships described by the IPCC (2013) amongst the institutions showed that, they were all in contact with parent institutions which were based outside the district. The public institutions for instance are controlled in terms of activities, human resources and financial resources at the regional and national levels by the Regional Coordinating Council and the Ministry of Local Government. The Masara N'Arziki Association is also controlled by a regional and national headquarters. The NGO's although they were formed locally, receive funding for their activities from external sources which are usually foreign based NGO's. SILDEP for instance has its climate change projects being financed by PLAN (Ghana) while ASUDEV has its climate change adaptation projects being funded by Action Aid (Ghana). Tudridep on the other hand being a religious based organization receives funding from the church but has its climate change projects being financed by Action Aid (Ghana) which is foreign based NGO.

#### **4.4 Respondents Perception on the Occurrence of Climate Change**

All the 160 farmers interviewed attested to the fact that they had observed some changes in the environment. Responses from institutional heads and farmers' description of the climate pattern of the area indicated that, the weather/ climatic conditions of the area had always been harsh. However, according to them, for some years now they had observed

that the weather/climate had become harsher. This was affirmed by responses received from the institutional interviews in which all the officers stated that, the area was experiencing some impacts of climate change. These changes, they stated were evident in the occurrence of flooding, droughts and higher temperatures (Source: Field Survey, 2014), all of which have been described by the IPCC as impacts of climate change in tropical regions.

Results displayed in Figure 4 shows that, about 50% (81) of the respondents stated that they had observed faster changes in the climate within the past five years. About 40% of this figure resided in the Sissala East District whilst 56% resided in Sissala West District. Respondents who stated that they had observed changed in the climatic patterns over the past 10 years were made up 33% (53) of the sample. A breakdown of respondents within this group by location revealed that, 25% of this figure resided in SED while 41% resided in SWD.

The analysis further showed that, about 13% (20) of respondents had observed climatic changes in the past 15 years. About 24% of them resided in SED while 1% lived in SWD. All of the 4% (6) of the total sample who reported to have experienced changes in climatic conditions within (2%) and over (2%) the past 20 years resided in SED. This analysis shows that, while the range of experience is spread within the SED, responses from the SWD show a more recent experience in the climate change phenomenon with about 99% of the sample collected from the district reporting to have experienced these changes within the past 10 years.

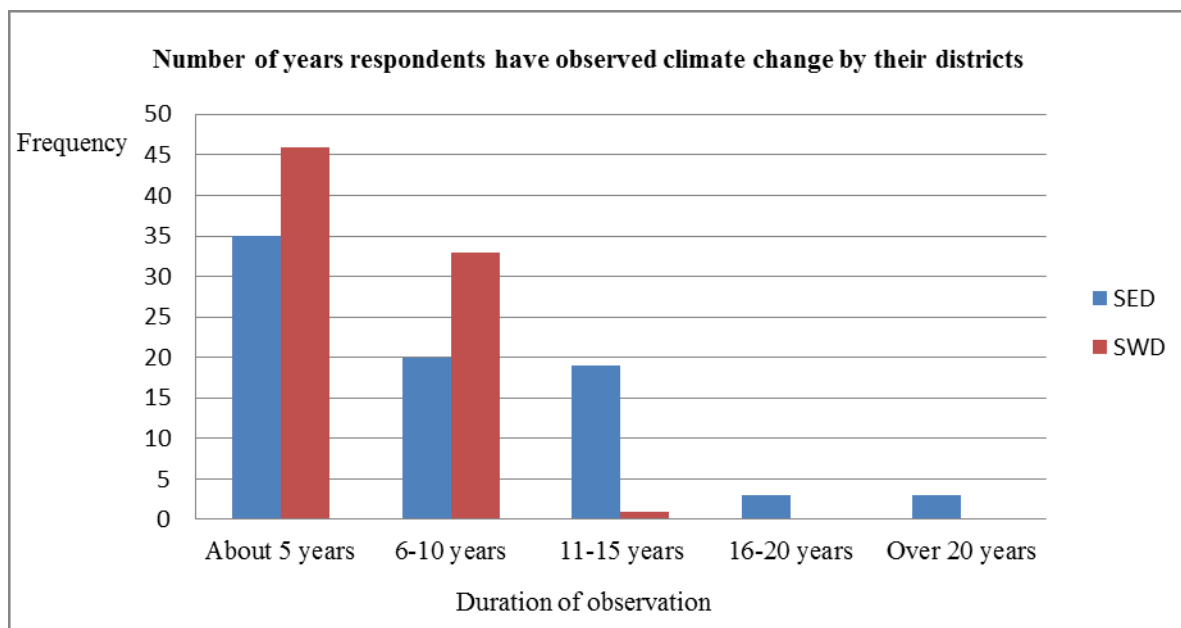


Fig 4: Number of years respondents have observed climate change

To corroborate the claims of the farmers, climate data of the agro-ecological zone from 1960 to 2011 was acquired from the Ghana Meteorological Agency. To make analysis easier, the data was divided into two periods of 26 years. This was done to aid the study successfully conduct  $t$ -test and  $f$ -test on the data. The first group ranged from 1960-1985 (Period [P] 1) and the second spanning from 1986-2011 (Period [P] 2). Although there were some missing data, they will however not much influence on the data analysis as the missing data appeared in months when no rainfall was experienced in the ecological region.

#### 4.4.1 Rainfall

Table 2 presents the results of the  $t$ -test performed on the rainfall data. Results indicate that, the mean rainfall of the ecological zone during the periods of analysis slightly decreased in P2. Additionally, results show that, the annual variation in the amount of rainfall experienced in P1 is higher than in P2 rainfall except for some 10 years when P2

had a higher variation in mean rainfall thus accounting for negative differences (Table 2). Furthermore, results of  $t$ -test at “ $a=0.05$ ” gave a result of 0.501 which is less than  $t$ -critical (1.708). Indicating that though there is a deviation in the means of rainfall between P1 and P2, the statistical significance of the change is low. Thus, the null hypothesis, there is no significant difference in rainfall between the two periods (P1 and P2) is maintained.

Results of  $f$ -statistic calculated at significance “ $a=0.05$ ” gave a product of 1.46, which, is greater than  $f$ -Critical (1.96). However, result of “ $p$ ” = 0.354. Therefore, since “ $p < .05$ ”,  $H_0$  is maintained. There is no statistically significant difference in variation of rainfall experienced during P1 and P2 (Table 2).

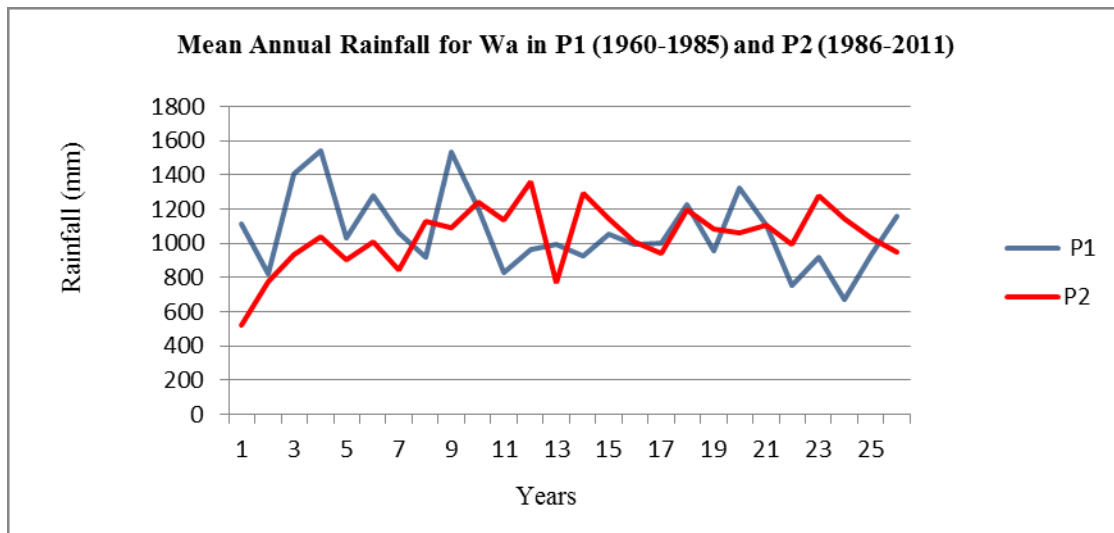
Table 2: Differences in mean annual rainfall experienced in Wa in P1 and P2

Year	P1	P2	Diff	Year	P1	P2	Diff
1	1116.9	522.9	594	14	922.8	1290.4	-367.6
2	818.1	776.6	41.5	15	1051.2	1141.2	-90
3	1403.9	930.5	473.4	16	996	1005.8	-9.8
4	1543	1042.3	500.7	17	999.1	939.3	59.8
5	1033.1	906.3	126.8	18	1225.7	1199.4	26.3
6	1275.273	1007.8	267.47	19	957.7	1080.2	-122.5
7	1058.4	841.2	217.2	20	1325.5	1060.8	264.7
8	920.1	1130.2	-210.1	21	1104	1102.691	1.31
9	1533.8	1090.691	443.11	22	755.7	996.7	-241
10	1206	1244.1	-38.1	23	919.4	1275.1	-355.7
11	832.4727	1134.6	-302.1	24	670.3	1141.7	-471.4
12	960.7	1357.8	-397.1	25	936.7	1032.2	-95.5
13	995.2	767.3	227.9	26	1157.127	946	211.13

Source: GMET, 2014

Results displayed in figure 5 shows the trend of rainfall for P1 and P2. From the graph, it is observed that, the rainfall pattern of the area undergoes cycles of highs and lows. Although P1 generally marked a period of higher rainfall, the graph of P2 seems to chase

after it and at some points the two trend lines merge. This may explain why results of statistical could not determine differences between rainfalls in the two periods. Again the graph shows that, although P1 recorded the highest rainfalls recorded in the area, it also recorded the year lowest rainfall ever experienced. Again, the graph shows that, during P2, rainfall followed a similar pattern as P1 except during the 13th year and the period between the 22nd year and 26th year when the trend seemed to move in an opposite direction. The dip in 13<sup>th</sup> year of P2 marked a period of drought in Ghana (1983).



Source: GMET, 2014

Fig. 5: Annual trend of rainfall in Wa for Period 1 and Period 2 (P1 and P2)

#### 4.4.2 Temperature

Results of displayed in Table 3 shows that, the mean annual temperature recorded for Wa has increased in P2. Results of *t*-test indicated that, there was a statistically significant difference in the means of temperatures experienced in the ecological zone in P1 and P2. The result of *t*- test was -6.662 which is lower than *t*-Critical (2.020) at  $\alpha=0.05$ . Therefore, since " $p<.05$ ", it indicates that, the means are different therefore,  $H_0$  is rejected

in favour of  $H_1$ : there is a statistically significant difference in the means of temperatures experienced in P1 and P2.

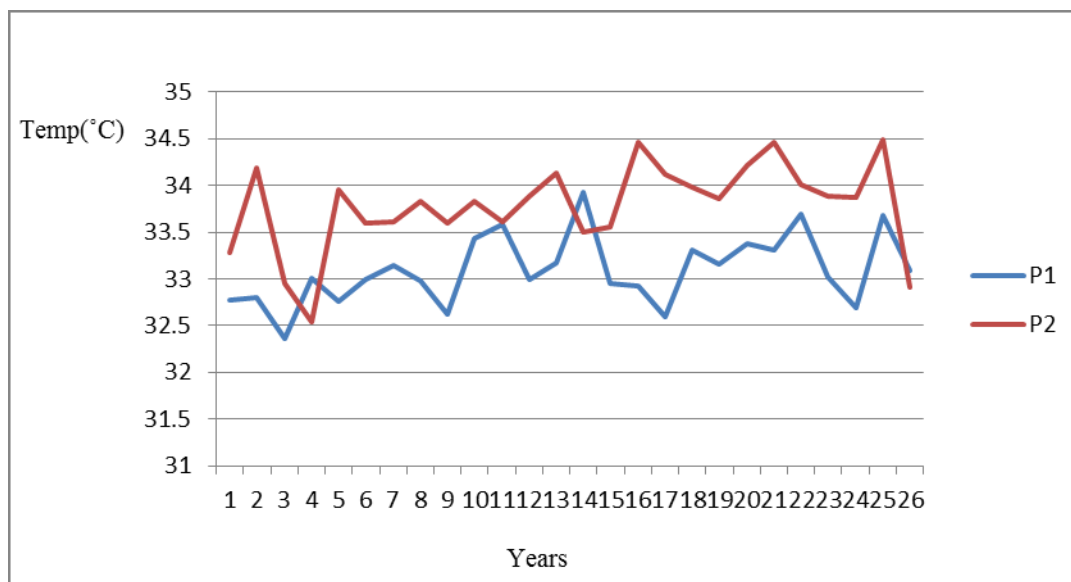
However,  $f$ -test indicates that, the statistical variation between the mean temperatures in P1 and P2 is not statistically significant. Results of  $f$ -statistic indicate that,  $f$ -test performed on the mean temperature at  $\alpha=0.05$ , gave a result of 0.62. Since this  $f$ -statistic is greater than  $F$ -critical (0.51), but “ $p<0.05$ ”, the study can conclude that, though there is a variation in temperatures of P1 and P2, the difference is no statistically significant. Therefore the null hypothesis is maintained.

Table 3: Differences in Wa’s mean annual temperature (1960-2010)

Year	P1	P2	Diff	Year	P1	P2	Diff
1	32.77514	33.28132	-0.51	14	33.92122	33.49421	0.427
2	32.80029	34.19018	-1.39	15	32.94732	33.55788	-0.61
3	32.35808	32.95663	-0.60	16	32.92329	34.46246	-1.54
4	33.00256	32.5332	0.47	17	32.58878	34.11556	-1.53
5	32.7527	33.95102	-1.20	18	33.30133	33.98176	-0.68
6	32.9882	33.59657	-0.61	19	33.16323	33.85363	-0.69
7	33.1475	33.61223	-0.46	20	33.37736	34.21197	-0.83
8	32.9791	33.83205	-0.85	21	33.30662	34.46729	-1.16
9	32.62209	33.60122	-0.98	22	33.69723	34.00256	-0.31
10	33.4291	33.82771	-0.40	23	33.02255	33.88366	-0.86
11	33.58326	33.60986	-0.03	24	32.68665	33.87125	-1.18
12	32.99588	33.886	-0.89	25	33.67713	34.48835	-0.81
13	33.16685	34.12506	-0.96	26	33.08395	32.91644	0.168

Source: GMET, 2014

Results displayed in Figure 6 shows the trend in temperature for P1 and P2. Although the temperature of the area is generally high, the graph shows that, temperature in P2 is higher than in P1. The graph also reveals contrasting trends in the year on year rise and fall of temperatures in the ecological zone leading to a negative relationship in the temperatures between the two periods.



Source: GMET, 2014

Fig. 6: Trends in Annual Temperature in Wa for Period 1 and Period 2 (P1 and P2)

#### 4.4.3 Respondents' perceptions on the causes of climate change

When respondents were asked about the causes of changes in the climatic patterns as they were now experiencing it, 73% (116) stated that, human activities were to blame. Approximately 11% (17) attributed the changes to God while 9% (15) of the sample believed human activities could be blamed for the present changes, they could not specify which human activities led to the changes (Table 4).

Results displayed in Table 4 shows that, about 27% (43) of the respondents who attributed climate change to be caused by human activities stated that, tree cutting could be the cause of climate change. The next human activity to receive most response as a cause of climate change was bush burning which 24% (38) of respondents stated as a cause of the present changes they were experiencing in the climatic patterns being experienced in the district. Tilling the land with heavy machines and over/ misapplication of fertilizer followed with 14% (23) and 9% (114) of respondents respectively. Population growth was also cited by 6% (10) of respondents as a possible cause of climate change.

Table 4: Respondents perceptions on the causes of Climate Change

<b>Causes of Environmental Changes</b>	<b>Frequency</b>	<b>Percent (%)</b>
Cutting down trees	43	27
Bush burning	38	24
Tilling the land with heavy machinery	23	14
Over application of fertilizer	14	9
Population Growth	10	6
Cannot specify which human activity	15	9
God	17	11
<b>Total (n)</b>	<b>160</b>	<b>100</b>

Source: Fieldwork, 2014

Relating to the impacts of climate change, results from the field survey indicated that, all the farming households involved in the study in both felt impacts of climate change on their farming activities. When asked to state their personal experiences, all household heads involved in the study (n=160) attested that, the temperatures of the two districts had increased. This represents 19% of responses received for this question (Table 5). About 17% of the total responses received, representing 142 farmers involved in the study stated that, they had observed changes in the rainfall pattern of the district. In discussing the intensity of rainfall, 15% (122) of responses received for this question claimed that, they have witnessed increased cases of stormy incidents while 143 (17%) farmers revealed that, droughts had increased in the two districts. Out of the 160 farmer households involved in the study, 17% attributed loss of soil fertility to climate change whilst 15% stated loss of vegetative cover as impacts of climate change they had observed (please refer to Table 5).

Table 5- Observed Impacts of Climate Change in the Districts

Observed Impacts	Responses	
	N	Percentage (%)
Increased temperature	160	19
Changes in Rainfall Pattern and Duration	142	17
Increased Incidence of Storms	122	15
Increased Incidence of Droughts	143	17
Loss of Soil Fertility	140	17
Loss of Vegetation Cover	120	15
<b>Total</b>	<b>586</b>	<b>100</b>

n=160

Source: Field Survey, 2014.

#### 4.4.4 Observed impacts of climate change on farming activities.

Results displayed in Table 6 shows the responses of household heads on how the impacts of climate change had affected their farming activities. About 24% (135) of the total sample stated that, due to the changing climatic patterns, they were experiencing low yields. Approximately 22% (130) of the farming households stated that they had experienced cases of plant pests and diseases which they attributed to changes in rainfall patterns.

Results displayed in Table 6 shows that, 131 households representing 22% of the sample stated that they had lost their crops to floods and long periods of drought. Additionally, results indicate that, 5% of the farm households (31) stated that, impacts of climate change affected not only their farms but also their health and infrastructure. They explained to affect their productivity as they tend to lose some working days in the bid to nurse back their health or replace infrastructure.

Additionally results presented in Table 6 shows that, 16% of respondents representing 99 households had experienced cases of animal diseases while 12% (77) of farmers stated that they had lost animals due to these climatic changes. This may or may not be solely attributed to climate change as most of these animals are reared in the free range system without adequate housing, feed and drugs.

This question had multiple choice answers, this therefore accounts for the large total.

Table 6- Impacts of Climate Change on Farming

Effect	Frequency	Percentage (%)
Low Yields	145	24
Plant pest and diseases	139	23
Animal diseases	99	14
Animal mortality	77	12
Loss of crops due to flooding/ drought	131	22
Human diseases	19	3
Destruction of properties	12	2
<b>Total</b>	<b>622</b>	<b>100</b>

N=160

Source: Field Survey, 2014

#### 4.5 Actions Farmers Have Taken to Adapt to Climate Change

Results displayed in Figure 7 shows that 77% (123) of farmers stated that they had over the years undertaken some measures on their farms to address the problems they were encountering in their farming activities due to climate change. Respondents who stated that they had done nothing prior to institutional support made up 23% (37) of the sample (Fig. 7).

A look at the distribution of the respondents and their location showed that, a majority in of respondents who had taken steps on their own to adopt climate change were residents the Sissala West District. This was represented 42% (68) of respondents while 32% (51) of respondents who had taken steps to adapt resided in the Sissala East District. Additionally, Fig. 7 shows that, 18% (18) of respondents who had not taken steps towards adaptation resided in the Sissala East District while 5% (12) were from the Sissala West District.

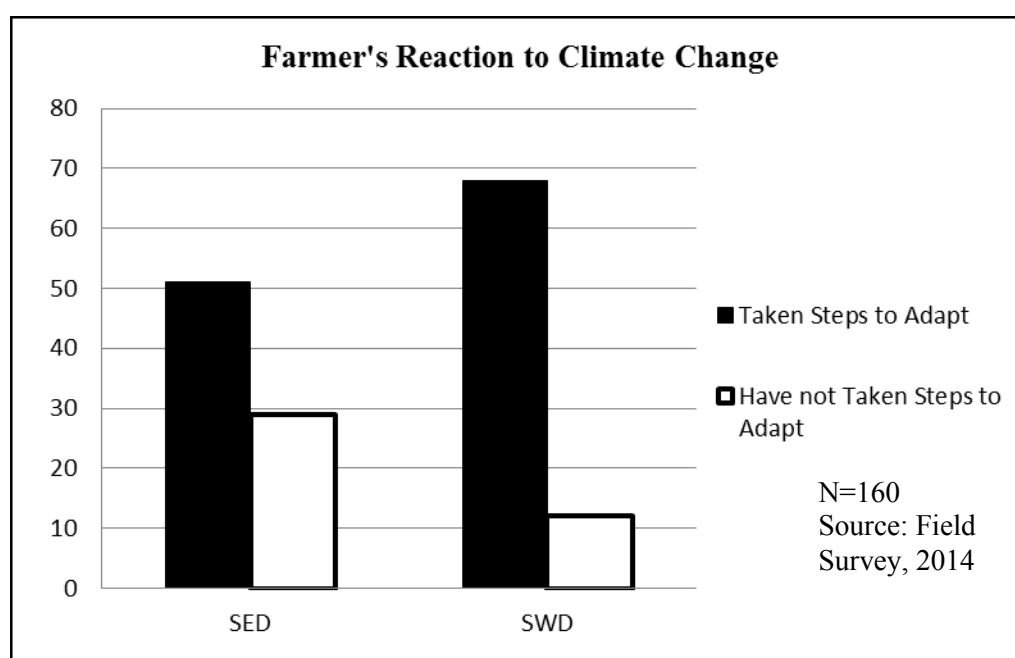


Fig. 7: Farmer's reaction to climate change – whether to adopt or not

#### 4.5.1 Measures Undertaken by Farmers and their Effectiveness

Respondents who stated that they had carried out some measure on their farms to cope with climate change were probed on what measures they had actually implemented, household heads stated the following: application of compost, fertilizer application, tree planting, shifting cultivation, use of improved seeds, changing planting dates to suit the rainfall pattern and land rotation as measures they had implemented. The study probed

further to find out the effectiveness of the measures they had put in place. Results indicated that, 85% (580) of all the responses received from the field on this question rated their measures effective while 15% (94) stated that they had not seen any improvement since they implemented those measures on their farms (Table 7). As displayed on Table 7, responses per an adaptation choice were high as farmers implemented a combination of measures to help them adapt to the changes they were experiencing. This accounts for the high frequencies recorded.

Results displayed in Table 7 shows that, 13% (82) of farmers who respondents stated that, they applied compost to the soil. While 87% (72) of households who used this method rated it as successful, 12% (10) rated this measure as unsuccessful. Furthermore, results indicate that, 17% (108) of household heads stated that, they applied fertilizers to enrich the soil. While 69% (74) rated fertilizer application effective, 31% (34) rated it ineffective (Table 7).

Conservation agriculture and tree planting on farms are other strategies farmers stated to have implemented on their own. Results indicate that, approximately 9% (58) respondents stated that they practiced conservation agriculture as a measure to handling the problem of excessive heat on their farms. Table 7 shows that, 93% (54) of them rated conservation agriculture effective while 7% (4) rated it ineffective. Additionally, results displayed in Table 7 shows that, 9% of respondents stated that they planted trees on their farms. Results show that while 86% (51) rated tree planting effective, 14% (8) rated it ineffective.

Table 7 - Measures taken by farmers themselves to handle the situation by their effectiveness

Measures	Effective	Non-Effective	Total (%)
Composting	72	10	13
Fertilizer Application	74	34	17
Conservation Agriculture	54	4	9
Tree Planting on-farm	51	8	9
Use of Improved Seeds	98	10	17
Changing Planting Dates	87	21	17
Crop Rotation	63	4	10
Land Rotation	52	0	8
<b>Total</b>	<b>551</b>	<b>92</b>	<b>100</b>

N=106

Source: Field data, 2014

Approximately 17% (111) of the total responses receive from farmers on the strategies they were implementing stated that they used improved seeds (Table 7). From of this proportion, 88% (98) rated this measure as effective while 12% (13) rated it ineffective as displayed in the Table 7. Furthermore, results presented in Table 4 shows that, 15% (96) of respondents stated that, they constantly changed their planting dates to fall within the observed rainfall season for the years. Out of this proportion of farmers, 78% (75) rated the measure as being effective while 22% (21) rated the measure non-effective.

Additionally, results in Table 7 shows that, 13% (82) of respondents stated that, they had implemented crop rotation as a measure to handle falling yields as a result of climate change. While 91% (78) of farmers who implemented this option rated crop rotation effective, 9% (4) rated it as non-effective. Furthermore, 8% (52) respondents stated that they used shifting cultivation as a measure to handle the challenges posed by climate

change to their farming activity. As indicated on Table 7, all the households that implemented shifting cultivation rated it effective.

#### 4.6 Access to Institutional Support in the Study Area

Results from the field indicated that, institutions in both districts were offering some form of support to farmers to help them adapt to climate change. Table 8 displays that, 63% (100) of households sampled for the study received institutional while 37% (60) of households involved in the study did not receive any form of institutional support.

Table 8: Farmers' access Institutional Support

Access to Institutional Support	Frequency	Percentage (%)
Receive support	100	37
Do not Receive support	60	63
<b>Total (n)</b>	<b>160</b>	<b>100</b>

Source: Field Survey, 2014.

##### 4.6.1 Rate of access to institutional support in the study districts

Field results also indicated that, 62% (100) of the total sample received support while 38% (60) did not receive any support from institutions. Approximately 31% (49) of farmers in the study who received institutional support resided in the Sissala East District while 32% (51) resided in the Sissala West District. Results also showed that, 19% (31) of households sampled for the study who did not receive institutional support lived in the Sissala East District while 18% (29) lived in the Sissala West District.

While on the field, the researcher observed that, most of the respondents who were subscribed to receiving institutional support belonged to groups. These groups were not necessarily farming co-operatives, but rather, contact groups through which the institutions related with the people. This was confirmed by all the institutions which were

interviewed. While the District Agricultural Development Units (DADU/MoFA) of both districts stated that, they met with the farmers in groups to maximize the efficiency of their extension officers, Masara N'Aziki, SILDEP stated that, formation of groups was part of their operation style.

#### **4.6.2 Institutions from which farmers in the study districts received adaptation support**

When the proportion of the sample that received institutional support were asked about the institutions that offered them support, about 35% (75) of respondents stated that they received support from Masara N'Aziki (Figure 8). Approximately 28% (60) of respondents received support from DADU/MoFA while SILDEP had 20% (43) of respondents being subscribed to their adaptation intervention. Results in Figure 8 show that, 9% (20) of respondents received support from the District Assembly; 5% (11) received support from ASUDEV while 3% (5) received support from TUDRIDEP. This question had multiple choice answers. This accounts for the high frequencies being recorded.

When respondents were further investigated to find out what support they received from the institutions, beneficiaries of the Sissala East District Assembly stated that, they were provided with tree crops to grow on their farms/ to set up community forests; they were also provided with ruminants such as goats and sheep to rear as a form of livelihood diversification and provision of flood relief. Respondents who were beneficiaries of the Sissala West District assembly stated that, they were provided with flood relief; they were called upon during the dry season to repair dams at a price and growing of trees around water bodies especially dam sites.

Furthermore, respondents who were subscribed to the District Agricultural Development Units (DADU/MoFA) support stated that they benefited from their training and demonstration programs. Similarly, respondents on Masara N'Arziki support also stated that they received input supply of seeds and fertilized and linkage to market.

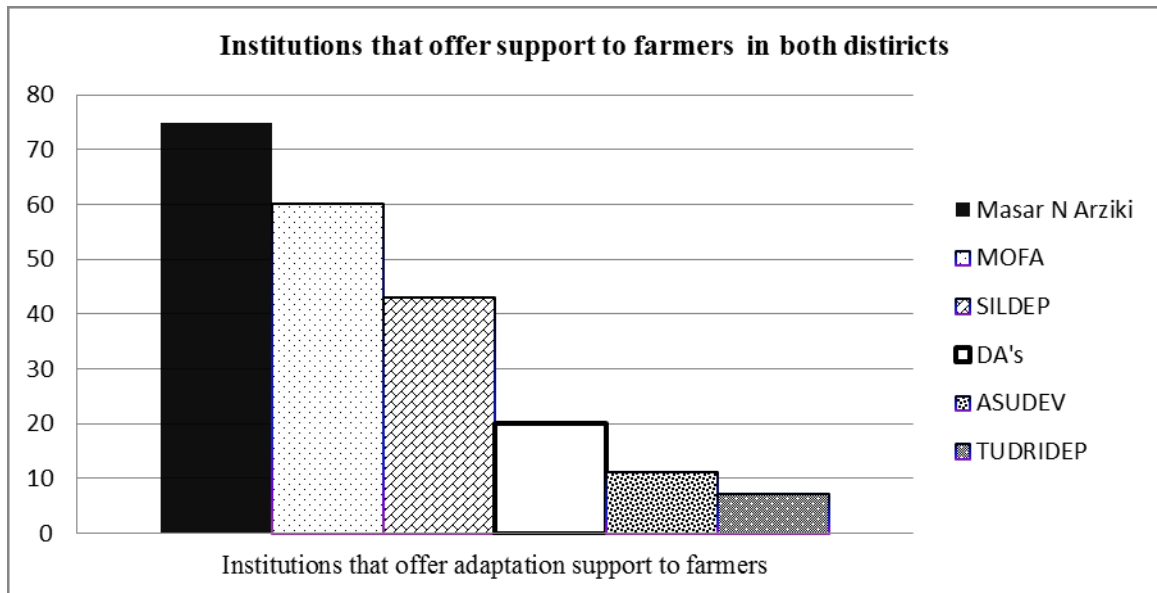


Fig. 8: Number of households which received support per institution

Additionally, respondents on SILDEP support in the two districts mentioned micro-finance (VSLA), livelihood diversification through networking women engaged in handicrafts, shea-butter, and soap and dawadawa production to markets. Respondents who stated that they received support from ASUDEV mentioned that, they were provided with donkeys for animal traction, were supplied with trees to grow on their farms and received flood relief. When this was corroborated with the institutional interviews, all the institutions mentioned educational campaigns as part of the support they gave to the farmers in order to make them aware of the implications of their activities on the climate. Again, the two district assemblies stated that, they were not involved in flood relief services but rather, it was a response of the National Disaster Management Organization

(NADMO) which the assemblies offered their support. The Sissala East District Assembly also stated that, provision of trees was in conjunction with the forestry commission.

Additionally, the results presented in Table 9 shows the distribution of respondents by their location and the institutions from which they received support. Results indicate that, 49% (49) of respondents who received support were residents of the Sissala East District. Approximately 16% (36) of respondents who received support in the Sissala East District were beneficiaries of Masara N' Aziki. Still in the Sissala East District, 13% (29) of respondents received support from DADU/MoFA while 14% (29) received support from SILDEP. Results in Table 9 further shows that, 3% (6) of respondents who received support in the Sissala East District claimed they received support from the District Assembly, while 2% (4) received support from ASUDEV and another 2% (5) received support from TUDRIDEP.

Figures displayed in Table 9 for the Sissala West District indicate that, 51% (51) of respondents who received support were from there. The table shows that, 17% (39) of respondents who received support in the Sissala West District were beneficiaries of Masara N'Aziki while 15% (32) of respondents received support from DADU/MoFA. Additionally, Table 13 displays that, 7% (14) of respondents who received institutional support and resided in the Sissala West District benefitted from SILDEP. Furthermore, 4% (7) of respondents who received support in the Sissala East District claimed they received support from the District Assembly. No respondent in the Sissala West District received support from TUDRIDEP as Table 9 shows.

Table 9: Institutions by location of beneficiaries

LOCATION	INSTITUTIONS						TOTAL (%)
	Masara N' Arziki	MoFA (DADU)	SILDEP	DA	ASUDEV	TUDRIDEP	
SED	36	29	29	6	4	5	49
SWD	39	32	14	14	7	0	51
<b>TOTAL</b>	<b>75</b>	<b>60</b>	<b>43</b>	<b>20</b>	<b>11</b>	<b>5</b>	<b>100</b>

Source: Field Survey, 2014

#### 4.5.3 Influence of sex to access to institutional support in the two districts

Further analysis conducted on the sex distribution of male headed households that received support to female headed households that received indicated that, about 36% (58) of households that received support were male headed households while 26% (42) of households that received institutional support were female headed households. Again, approximately 27% (43) of households involved in the study who did not receive institutional support were male headed while 11% (17) of female headed households involved in the study did not receive institutional support.

A chi-squared analysis was conducted to test the level of relationship between access to institutional support and sex showed that, there was a weak relationship between these variables.

The test statistics,  $X^2 = 3.009$ ,  $df=1$ ,  $p\text{-value} = 0.083$ . Since  $0.083 < 0.01$ , the study can therefore conclude that, there is no relationship between sex and access to institutional support in the two districts. Institutions in the district therefore did not consider gender before offering support to the farmers.

Though this analysis represents the general relationship between institutions in the two districts and access to institutional support, a review into the relationship between accesses by institution might show that, some institutions specifically introduce

adaptation strategies that will help address the need of a particular sex. For instance in the interview with the SILDEP director, he stated that, their micro finance service was initially directed at women in the two districts as they formed the most vulnerable group within the district. Furthermore, the Sissala East District Assembly specifically identified women to be the beneficiaries of their support under the Africa Adaptation Project as they are vulnerable and usually lack wider agricultural bases adaptation options since land in the districts was controlled by males. Additionally, the Sissala West District Assembly projects of dam reconstruction and repairs were mainly directed at male household heads.

#### **4.5.4 Influence of Age on Access to Institutional Support in the Two Districts**

Results displayed in Table 10 shows that, more than half the sample fell within 40-59 age bracket. This is represented by 52% (84) of the total sample. Out of this proportion of respondents, 59% representing 49 households received support from institutions while 41% (20) did not receive support from institutions.

The next age bracket that was highly represented in the sample is the 18-39 age group. Figures in Table 10 shows that, 32% (63) of them were involved in the survey. Approximately 68% (43) of this proportion of respondents received support while 32% (20) stated that, they received no support from institutions to help them adapt to climate change.

The 60+ age range was the least represented in the sample as 9% (14) of respondent in the total sample fell within this range. From Table 10, 57% (8) of respondents who were 60+ stated that, they received some form of support from institutions to help them adapt

to climate change. Whilst 43% (6) of respondents within the 60+ age stated that they received no support from institutions.

Table 10- Age of respondents and their access to institutional support

	Age	Support	Not Supported	Total (%)
<b>Age</b>	18-39	43	20	39
	40-59	49	34	52
	60+	8	6	9
	<b>Total (n)</b>	<b>100</b>	<b>60</b>	<b>100</b>

Source- Field Survey, 2014

The Chi-square test was also conducted to test whether there was any association between age and farmers access to institutional support. This gave a result of 1.48 which is also greater than 0.1, therefore, conclusions can be drawn that, there is no association between age and access to institutional support. It can thus be concluded that, the statement made by some of the farmers and institutions that behavioural traits such as lack trustworthiness and laziness as factors that hinder smallholders access to institutional during interviews holds true.

#### 4.7 Coping Strategies Adopted by Households

In this section, the coping strategies households employ to adapt to climate change is presented. In order to get a real picture of what the farmers do, the analysis is done in two ways. The first part looks at the coping strategies developed by households before they subscribed to institutional support. This group is made up of respondents who received institutional support. The second part looks at coping strategies that are used by households that do not have access to institutional support. Results of analysis showed that, 63% (100) of farmers had access to institutional support while 37% (60) had no

access to institutional support. However, since households combine coping strategies, the responses received for each group was high.

#### **4.7.1 Coping strategies adopted by households before receiving institutional support**

Results in the Table 11 indicates that about 12% (53) of the respondents that had institutional support stated that, they used to migrate to other parts of the country to engage in economic activities due to the problems they were facing in their agricultural activities. About 94% (49) household heads that were migrating were male headed. Female headed households migrated least.

Results displayed in Table 11 shows that, shifting cultivation is another coping strategy formally implemented by 14% (55) households now receiving institutional support. Respondents stated that, they used to practice shifting cultivation to ensure soil fertility. Results displayed in Table 11 shows that, shifting cultivation is a strategy that was taken up by more men than women. About 93% (82) of that stated they used shifting cultivation as a coping strategy was male headed whilst 7% (8) of households which adopted this strategy was female headed households. This might be explained by the cultural practice of the Sissala which does not give women land ownership right. A look at the distribution of the sample by location and gender showed that, a total of 45% (24) of respondents who adopted this strategy resided in the Sissala East District. This is composed of 40% (21) male headed households and 5% (3) female headed households in the Sissala East District opting for shifting cultivation. Additionally, results in Table 11 results show that, 55% (29) of respondents who adopted shifting cultivation resided in the Sissala West District. While 53% were male headed households only 2% of households which adopted shifting cultivation were female headed households residing in the Sissala West District.

Results displayed on Table 11 shows that, both male and female headed households were equally engaged in the activity of hunting and gathering. It received the highest response from respondents and could therefore pass as the most widely used strategy of all households irrespective of the sex of the household head. From Table 11, approximately 21% (95) of households now receiving support stated having ever adopted it as a strategy to sustain the family during times of poor yields. Figures displayed in the table indicate that, out of the 95 households that opted for this strategy, 24% (23) were male headed households residing in Sissala East District while 34% (32) resided in the Sissala West District (Table 11). Additionally, results displayed in Table 10 shows that, 23% (22) of female headed households in Sissala East District and 19% (18) female headed households in the Sissala West district stated they used to hunt and gather wild fruits during times of food scarcity.

Table 11- Coping strategies employed households with institutional support prior to receiving support

Gender	Location	Coping Strategies							Total (%)
		M	H.G	A S	Borrow	FR	SC	D /S P	
Male	SED	21	23	23	17	11	20	0	25
	SWD	28	32	33	15	3	31	0	33
Female	SED	3	22	10	21	22	3	18	24
	SWD	1	18	6	18	17	1	17	18
<b>Total (n)</b>		<b>53</b>	<b>95</b>	<b>20</b>	<b>71</b>	<b>12</b>	<b>55</b>	<b>9</b>	<b>100</b>

Source: Field Survey, 2014.

Key: **M** – Migrating; **H.G** – Hunting and Gathering; **AS** - Asset Sale; **FR**- Food Rationing; **SC** – Shifting Cultivation; **D /SP** - Shea Butter /Dawadawa and Handicraft Production

Results of the data analysis shows that, about 20% (71) of responses from households which received institutional support indicated that, they had ever borrowed money or food in the past (Table 11). The data also shows that, more female headed households

opted to borrow than male headed households. A breakdown of the distribution shows that, about 45% (33) of this number were male headed households. Out of which 24% (17) resided in Sissala East while the rest were from the Sissala West District (Table 11). Female headed households which borrowed were about 55% (39) of the proportion of the sample that now receive institutional support. As displayed in Table 8, 30% (18) of them lived in the Sissala West District.

Gender differentiation is seen in the distribution of male and females for the asset sale and shea nut processing. Data displayed in Table 11 shows that, more men in the two districts are involved in the activity of asset sale than women as 78% (66) of males and 32% (16) females who were receiving support used to engage in the activity. Table 11 shows that, 31% (23) of male household heads and 14% (18) female household heads who used to sale their assets reside in the Sissala East District. Additionally, figures presented in the table shows that, 46% (33) of male household heads and 8% (6) who stated that they used to adopt sale their assets resided in the Sissala West District.

Results presented in Table 11 shows that, 2% (35) of households stated that they used to process shea- nut and dawadawa as coping strategies before they were enlisted for institutional support. No males were engaged in the activity of shea and dawadawa processing in the two districts. The location distribution shows the proportion of respondents who used to opt for this adaptation strategy were equally distributed in the sample with about 50% of women in both districts included in the sample attesting to the fact they used to process these products as a coping strategy.

A detailed analysis of the coping strategies adopted by households shows a trend in adaptation choice by gender. Strategies such as migrating, sale of assets and shifting cultivation were mainly male dominated strategy as males have the power to control resources, make decisions and are generally more mobile than women. Other strategies such as processing of dawadawa and sheanut were dominantly a female activity. Food rationing was more common in female headed than in male headed households. This might be attributed to the fact that, more female headed households are resource poor than male headed households. Both genders equally engaged in hunting and gathering though there again there was a gender disaggregation as males tend to do more hunting which involved killing game and women involved in gathering of fire wood and wild foods and fruits to sustain their families.

#### **4.7.2 Coping strategies of households not receiving support**

To find out if these adaptation strategies were true, farmers who were not receiving any form of support from institutions were asked to state the adaptation strategies they had developed and were using to handle the changing climates today. Results in Table 12 indicate that 60% (36) of the respondents that did not receive institutional support was male while 40% (24) was female. A look at their locations shows that, 42% (25) of respondents who did not receive institutional were male headed households residing in the Sissala East District. Approximately 30% (18) of male headed households who did not receive institutional support were residents of the Sissala West District. Female headed households which did not receive support composed 28% (17) of the total number of respondents who did not receive support. Approximately 18% (11) were residents of the Sissala East district while 10% (6) were resided in the Sissala West District.

Looking at the gender, location and adaptation strategies used, here again, one can see that, there is a gender differentiation in the adaptation strategies adopted by the households. More female headed households than male headed ones are involved in the processing of dawadawa, sheanut and production of handicrafts in both districts. Results indicate that 8% (25) of households were engaged in the processing and handicraft activity. Approximately 56% (14) of them are female headed households while 34% (11) of households which engaged in the processing and handicraft activity were male headed. Migration is also more popular with male headed households than female headed households. With reference to Table 12, about 12% (34) of respondents disclosed that, they migrated to other parts of the country to work. Approximately 82% (28) of them are males while 18% (6) are female house hold heads.

As presented in the Table 12, about 14% (44) of farmers who did not receive institutional support stated that they were adapting to the changing climate by growing improved seeds. This shows that, modern adaptation methods introduced by institutions were familiar to some of the farmers who did not receive institutional support. This might be attributed to the close ties the people have with each other therefore, making it possible for farmers who receive institutional support to share technology and knowledge with those who did not receive institutional support. Within this group, more male headed households [80% (35)] had adopted this strategy than female headed households as is displayed on Table 12.

Mixed cropping ranked as the next highest adaptation strategy being used by 14% (42) of farmers who did not receive institutional support. About 79% (33) of these households

were male headed. Figures displayed in Table 12 shows that, 21% (9) of female headed households adopted mixed cropping as a coping strategy.

Table 12: Coping strategies adopted by respondents without access to institutional support by their gender and location

Gender	Location	Coping Strategies									Total (%)
		I.V	R.A	Borrow	Migrate	A.S	C.R	M.C	S.C	S/D & H P	
Male	SED	19	21	8	12	9	12	20	10	4	25
	SWD	16	13	10	16	12	4	13	15	7	18
Female	SED	4	3	6	4	5	9	4	3	9	11
	SWD	5	2	3	2	5	3	5	2	5	6
<b>Total (n)</b>		<b>44</b>	<b>39</b>	<b>27</b>	<b>34</b>	<b>31</b>	<b>28</b>	<b>42</b>	<b>30</b>	<b>25</b>	<b>60</b>

N=60

Source: Field Survey, 2014

Key: **I.V** - Improved Varieties; **R.A** - Rearing Animals; **A.S** - Asset Sale; **C.R** -Crop Rotation; **M.C** - Mixed Cropping; **S.C**- Shifting Cultivation; **S/D & H P** - Shea Butter /Dawadawa and Handicraft Production

Looking at the results presented in Table 12, there is once again a gender differentiation in the coping strategies adopted by households. Strategies such as migration and animal rearing were more popular with male headed households than female headed households. This might be due to the fact that, males are more mobile than females and on the aspect of animal rearing proves the statement by the institutions that, in the Sissala culture women are not allowed to rear animals such as goats, sheep, cattle and guinea fowl. Again, it was realized that, though men fell within the group of processing and handicraft production, most males were involved in the handicraft production whilst shea-butter and dawadawa production was mainly a female activity.

Comparing the results of this table (Table 12) to those displayed on Table 11, one can infer that, although smallholders have traditionally developed some strategies with which

they cope with climate change, adoption of these strategies is dependent on issues such as wealth, social networking, gender to mention a few. Additionally, although some farmers stated that they were not receiving institutional support, it can be deduced that, they had implemented some strategies that are from institutional sources. This they may have acquired through their social networking relations with other farmers. These strategies included use of improved varieties of seeds and crop rotation.

#### **4.8 Effect of Institutional Support on Smallholder Adaptation**

To be able to measure the effectiveness of institutional support in the two districts, a Chi-Squared test was performed against the hypothesis,

$H_0$  = There is no significant difference in the influence of institutions in climate change adaptation

Results from the Chi-Squared analysis indicated that, calculated  $X^2$  Statistic at 1 degree of freedom is 42.835. Moreover, the results showed that, the level of significance is 0.000 which is less than the normal value of 0.05. This suggests that, the null hypothesis,  $H_0$  = There is no significant difference in the influence of institutions in climate change adaptation, is rejected in favour the alternate hypothesis,  $H_0$  = There is a significant difference in the influence of institutions in climate change adaptation.

#### **4.9 Challenges smallholders face in accessing institutional support**

Results from the field indicated that, about 75% (120) of the sample stated that there were some challenges to accessing institutional support. As shown in the Fig. 9, about 9% (15) of the sample stated that, they experienced no challenges in accessing institutional

support while 16% (25) of the sample declined to answer this question even though they were prompted for answer during data collection.

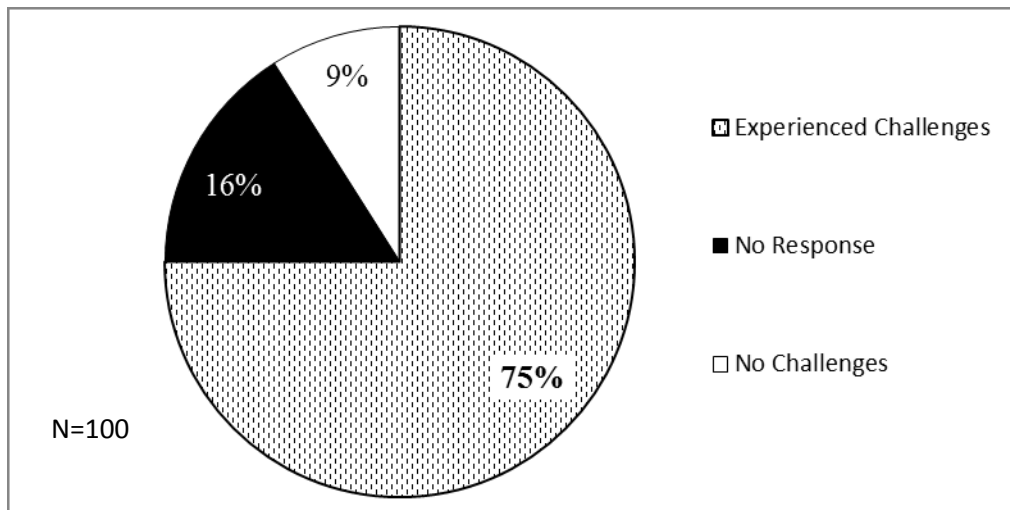


Fig. 9: Proportion of respondents who faced challenges in accessing institutional support

The study further asked farmers who stated that they faced challenges in accessing institutional support to list challenges they faced in accessing institutional support. A total of 263 responses were received for this question. A majority of this proportion of farmers cited the lack of accurate information as a barrier to accessing institutional support.

Table 13- Issues that affected respondents access to institutional support

Challenges	Responses	Percentage
Lack of information	97	37
Language barrier	78	30
Low education	49	19
Poverty	22	8
Trust	12	5
Age	5	2
<b>Total</b>	<b>263</b>	<b>100</b>

Source: Field Survey, 2014.

Respondents explained lack of information to mean the little or no information the existence of institutions involved in adaptation and the services they provide to farmers on adaptation as a major challenge to accessing institutional support. This group of responses represented by about 37% (97) of the total responses received as displayed in Table 13.

Additionally, Table 13 shows that 30% (78) of respondents stated language differences between themselves and the representatives of institutions as a barrier to accessing institutional support. Additionally, 19% of responses received on this question cited the educational level of the household head as a barrier to accessing institutional support. Poverty, behavioural traits such as low levels of trust and age of household heads were cited as factors that could affect households' access to institutional support. These challenges respectively represented 8% (22), 5% (12) and 2% (5) of the total responses received as shown in Table 13.

#### **4.10 Challenges Institutions Face in Providing Support to Farmers**

Results received from the field indicated that, institutions in the districts also faced some form of challenges in the process of offering adaptation support to smallholder farmers. Results of the analysis indicated that, the factors that resulted in challenges to institutions faced in providing support arose from two sources. These are the institutions themselves and the smallholder farmers. The next two sections present results of data analysed on the two sources of institutional challenges to providing adaptation support.

##### **4.10.1 Internal barriers to institutional support**

All institutions involved in the study except Masara N'Arziki identified with these constraints. From the analysis, it was deduced that, this constraints arises out of the

interaction between institutions and their co-institutions on the higher level (as is depicted in the interview extract). While the NGO's stress financial and personnel factors as a minor constraint, the public institutions identify both financial and human resources to be major constraints as funding and employment usually falls within the confines of the national level institutions. The only institution that did not cite financial resources as a barrier to their adaptation effort was the Masara N'Arziki Farmers Association as it is a business venture. They stated the late arrival of their inputs which will be supplied to farmers as one major problem which they explained to be related to internal issues within the consortium and also sometimes due to problems related to freight forwarding. Excerpts of the interviews are presented below.

*"We have limited resources especially funding and human personnel. However funding is the major constraint as funds are needed to pay our personnel and also run the projects. With more funding we can hire more people to work on our projects. Thus reaching a wider range of people."* (Source: TUDIDEP, 2014)

*"Our major problems are limited staff funds and transport."* (Source: DADU/MoFA-SWD, 2014)

*"We lack internally generated funds. The Government of Ghana support is also not forthcoming. We also lack extension officers which makes it difficult for us to reach many farmers in the district."* (Source: DADU/MoFA- SED, 2014)

*"The major constraint we face in our effort of giving support to farmers lies with the late arrival of our inputs which happens only a few times for example in 2011 and 2013."* (Source: Masara N'Arziki, 2014)

#### 4.10.2 Demand-side barriers that hinder institutional support

On the demand side barriers, all the institutions in both districts stated character traits as the major barriers. These included lack of showing financial commitment to pay for adaptation support and lack of showing commitment to adaptation projects. This results from the fact that, an institution has recognized the need for a particular adaptation strategy. However, the people for whom this strategy is meant do not see the need for it therefore do not accept it to ensure its success as is described by the interview with ASUDEV and the District Agricultural Development Unit Officer of Sissala West District. This relates directly to the findings of (Moser and Ekstrom (2010) and Jantarassami *et al.* (2010). Again, it ought to be mentioned that, some adaptation strategies such as tree planting do not succeed in northern Ghana due to their traditions norms of trees being owned by the chief. The director of SILDEP gave an interesting twist to the demand side barriers which has not been mentioned in earlier studies. These are political affiliations and lack of trust in NGO's. These barriers and their explanations can be seen in the extract below.

**Question:** *Do the farmers do anything that hinders your institution's efforts in providing them with adaptation support?*

**Answer:** *"Yes they do. The only thing is that, farmers want everything for free. When it is time for them to contribute something to ensure they adapt successfully, they draw back. For example, some time ago, a letter was received informing farmers in the district about the possibility of acquiring early maturing mango seedlings from Kintampo at a cost of C2.00. However, transportation will be free if they could order for 5000 seedlings. When*

*farmers were informed to contribute to cover the cost, they could not commit themselves to it.” (Source: DADU/MoFA- SWD, 2014)*

*“The major problem we face here is the practice where individuals set fire to the trees we (the communities with aid from the district assembly) have grown around the dams to protect them from the scorching sun. They also illegally win sand from the dams which sometimes cause some of them to collapse. Several calls made on the people to stop these practices fall to deaf ears especially the call on bush burning as it has been institutionalized in this district.” (Source: SWDA, 2014).*

*“Some of the farmers are not ready to contribute their quota to ensure the success of the projects. Let us take the tree planting exercise as an example. Some of the communities did not care for the trees by weeding and creating fire belts around them. This caused the trees to get burnt during the hot dry season.” (Source: ASUDEV, 2014)*

*“What prevents some of the people from coming forward is their past experiences with other NGO’s. Some of the farmers feel discriminated against by development workers and MoFA which arises out of political differences therefore they do not trust the NGO’s until they begin to see the effect of their activities.” (Source: SILDEP, 2014)*

#### **4.11 Improving the Linkage between Smallholder Farmers and Institutions**

Respondents were asked to recommend ways access to institutions could be improved considering the challenges they faced before accessing institutions. Results indicated that, 61% (98) of farmers involved in the study did not respond to this question whilst 39% (62) responded.

Results displayed in Table 14 shows the views of respondents on how farmers' access to institutions can be improved. From the table, 27% (38) respondents suggested that, institutions involved in agricultural development should open offices in major towns within the sub-districts to ensure that, farmers who need their services would not travel very far to reach them.

Table 14- Respondents views on how institutional access can be improved.

Item	Frequency	Percentage
Extend offices to sub-districts	38	27
Provision of information on institutions	32	23
Improvement of road networks	27	19
Employment of indigenes into institutions	43	30
Increasing the numbers of extension agents	1	1
<b>Total</b>	<b>141</b>	<b>100</b>

N=62

Source: Field Survey, 2014

Furthermore, 23% (32) of responses received stated that, institutions must educate farmers on their existence and services so that, farmers can access them when they needed to. Results displayed in Table 14 shows that, 19%(27) respondents reasoned that, road networks in the two districts must be improved to ensure that, officials of institutions who offer adaptation support can reach farmers in all parts of the district. 30% (43) respondents suggested that, institutions should employ more people who understand and speak the Sissala language to enhance communication flow between themselves and the officials of institutions. One respondent stated that, the numbers of MoFA extension agents be increased to ensure they cover a wider area than they do now. As farmers have over the years developed trust for extension officers and can thus freely inform them of their problems.

#### **4.12 Summary of Chapter**

In this section, the results of data acquired from the field was analysed and discussed in relation to other studies. This was done with the aim of bringing out the similarities and differences in the findings of this study and other studies and also, how the findings can be placed within the conceptual framework.

From the data received, the study concluded that, the climate of the Guinea Savannah Ecological Zone had changed causing some farmers to take up strategies to address the impacts these changes bring especially on their farming activities and also. Also, analysis of climatic data showed that, there was a trend in the rainfall patterns of the area which runs in cycles of highs and lows. The study also discovered that, there were institutions involved in climate change adaptation in the two districts. These institutions interact with each other and also with other institutions on the higher level thereby creating an enabling environment for adaptation activities or serving as sources of barriers to adaptation. Results from the field indicated that, respondents in both districts who received adaptation support from institutions described the adaptation support as effective as it has helped them increase their productivity and also adapt successfully to climate change. Results indicated as earlier studies discovered that, both institutions and farmers faced challenges when it came to giving or receiving adaptation, a situation both institutions and farmers both agreed to result from the institutional challenges and socio-cultural factors. However, results from this study reveal that, behavioural characteristics such as trust and hard work may also hinder an individual from accessing institutional support.

## CHAPTER 5

### DISCUSSION OF FINDINGS

#### 5.1. Chapter Outline

In this chapter, findings of data presented in Chapter 4 are interpreted and discussed. Reference will be made to tables and figures displayed in Chapter 4. The discussion is divided into eight sections. The first four sections discuss findings on the institutions in operation in the study districts, respondents' perception on climate change, how climate change has affected farming activities of respondents and actions they have undertaken to adapt to climate change. The subsequent sections discuss findings that are connected to the objectives of the study.

#### 5.2 Institutions Operating in the Districts

Findings from the field indicated that, the three main types of institutions described by Gortner *et al.*, 2007 and Agrawal, 2010 were in existence. These are state/ bureaucratic (public), private and civic institutions. As displayed in Table 1, the public institutions that were in operation in both districts are the District Assemblies and the District Agricultural Development Units (DADU/MoFA). These institutions were established by statutory provisions and have their resources and activities controlled by the state (Gortner *et al.*, 2007). Based on the analysis of interviews with the district assemblies of both study districts inferences could be made that, District Assemblies did not work directly with farmers however, they offered flood relief together with NADMO and also implement climate change projects which they run together with the District Agricultural

Development Units, NGO's and other state agencies that are involved in climate change such as the Forestry Commission.

The civic institution identified in the study area was a Co-operative Union which did not target farmers. Three Non-Governmental Organizations (NGO's) were identified in the two districts which were involved in climate change adaptation projects. They are SILDEP, TUDRIDEP and ASUDEV (Table 1). They are all privately run NGO's whose purposes are determined by officials within the organization and are funded by donor agencies to whom they hold their accountability (Gortner *et al.*, 2007).

Again, as postulated by Gortner *et al.* (2007), some institutions may not be clearly described as belonging to either one type of institution. The study encountered one of such institutions namely, Masara N'Arziki. This is because the nature of operations of the institution is neither purely private nor is it purely civic. Although the organization is a private entity with profit making as one of its aims, the Masara N'Arziki targets and encourages farmers to form groups which are based on characteristics such as trust, hard work and financial base. These groups serve as the channel through which farmers are offered support in the form of subsidised farming inputs at their door steps.

### **5.3 Respondents Perception on Climate Change**

Results of analysis on respondents' perception to climate change indicated that, all the respondent stated that they had observed changes in both rainfall and temperature. Statistical analysis conducted on rainfall showed that, although some variability was recorded in the mean rainfall of the period, it is low and statistically insignificant (Table 2, Fig.4) thus, contrasting the claims of respondents. Analysis of temperature however,

tallied with respondents' observation that the temperatures had increased (Fig. 5) as statistical tests indicated a significant change in temperature (Table 3).

Despite the low level of significance in rainfall experienced in the area, the study cannot successfully conclude that respondents perceived the weather wrongly perhaps had the study conducted an analysis into the monthly rainfall trends results might reveal changes in the duration and amount of monthly rainfall of the area in each year. Also, the analysis showed that the amount of rainfall recorded annually in area had decreased thereby confirming the findings of Owusu and Waylen (2009) that, there is a general decrease in the total annual rainfall recorded in the country.

Again, results of the analysis on the climatic data Results displayed in Tables 4 and 5 shows that, the knowledge about climate change and its causes within the farming population of the district is high. This is because, all the sampled population knew what climate change was and could describe what it was even though the question did not implicitly state climate change but rather environmental change. From their responses it can be deduced that, climate education within the districts is high and has been accepted by the people. This can confirm that, the radio campaign and face to face interactions involving institutional staff and farmers have been successful. Again, the study can infer that, at the informal level, farmers within the district interact and share information with each other thus household heads who do not own radio sets or belong to a farmer group receive information on climate change and adaptation from friends and relatives who have radio sets or belong to a farmer group.

Additionally, both farmers and institutions noted that, the area was experiencing some changes in the climate of the district. They explained the changes they were experiencing

to include increased occurrence of droughts during the rainy season and the dry season extending for longer time than they had previously observed. The farmers also stated that, rainfalls were now more intense and fell for shorter periods leading to flooding. The District Assemblies and Agricultural Development Units in both districts however stated that, flooding is not solely due to rainfall but also due to the yearly release of water from the Bagre Dam in Burkina Faso. These statements were compared to the National Disaster Management Organizations Data on floods within the Upper West Region. The report showed that, within the past 15 years four major flooding events have been recorded in the Sissala West and East Districts which resulted in loss of lives and properties including farms lands and produce. These floods occurred in 1999, 2007, 2009 and 2013. The 2013 flood was mainly attributed to the release of spill water from the Bagre Dam in Burkina Faso (NADMO, 2012).

This finding also relays with the findings of IPCC (2013) and Nigigi (2009) who found out through their various assessments that in the tropical areas, the major impacts of climate change will be felt in the climatic variables of rain and temperature. The conceptual framework is also supported by these statements. As the conceptual framework posits, stressors on the rural environment have trends and may be seasonal. As can be deduced from the farmers' response, there are seasonal trends in the occurrence of the climate change impacts they experienced. While droughts are associated with the dry season, floods usually occurred during the rainy season.

#### **5.4 Observed Impacts of Climate Change on Farming Activities.**

The responses received from the field directly relays with Morton's (2007) findings on the impacts of climate in agriculture within the tropical region and the conceptual

framework where the impacts of climate change have been identified to have both agricultural and non-agricultural impacts on societies. As displayed in Table 6 impacts of climate change stated by farmers range between those that directly affect their farming activities and those that affected the health and welfare needs of smallholder farmers. The Kundzewicz *et al.* (2007) found out as the farmers in this study have stated, that, climate change has the ability to affect the basic elements of food production such as soil, water and biodiversity. Therefore, there might be some truth in the farmers attributing loss of soil fertility in the study districts to climate change although more studies must be conducted to ascertain whether the climatic factors are solely the cause loss of soil fertility the soils in the districts.

### **5.5 Actions Farmers Have Taken to Adapt to Climate Change**

As stated in the Chapter 4, all respondents of the study stated that they had observed some changes in the climate which was affecting their productivity, the study sought to find out what actions they had undertaken on their own (outside institutional support) to address the problems they mentioned to be experiencing on their farms. However, findings indicated that, not all farmers had taken any response strategies on their own (Fig. 7). This corroborated by the findings of Fosu-Mensah *et al.*, (2012) that, though farmers may be highly aware of climate change, not all of them adjust their farming practices to reduce the impact of climate change on their productivity. The reason why some farmers may not be able to modify their activities could for instance be due to the alternating periods of droughts and floods for instance.

Additionally, from results presented in Tables 11 and 12, inferences can be made that, coping strategies used by most smallholder farmers in both districts before the receiving

institutional support were, livelihood diversification into on-farm and off-farm activities such as migrating and processing of forest products (shea nut and dawadawa) as cited by Yaro *et al.*, (2014), Hassan and Nmachena (2008), Agrawal (2010), Agrawal and Perrin (2008) and Mortimore and Adams (2001). Other coping strategies mentioned by the people were hunting and gathering foods from the wild, food rationing and shifting cultivation which were described by Alteri and Koofhaskan (2008) as strategies that improved the food base of smallholder farmers during periods of drought. During discussions respondents were asked why they chose these strategies, they explained that, these particular strategies were used by their forebears and they also believe they would help them cope with the changing trends as they called it. Again, a careful study of the strategies adopted by households which are now receiving support from institutions, shows that, institutions usually developed adaptation strategies based upon the coping strategies and needs of the people in the community as described by Agrawal (2010) and Agrawal and Perrin (2008).

### **5.6 Effect of Institutional Support on Smallholder Adaptation**

Results of Chi-Squared analysis presented in section 4.8 suggested that, there is a significant difference in the influence of institutions in climate change adaptation. This finding varies from that of Yaro *et al.* (2014) whose study described institutional support as ineffective. From field discussions, farmers indicated they had witnessed improvements in their farm productivity. Furthermore, respondents who received non-agricultural support also attested to the fact they had noted an improvement in their incomes due to their participation in the VSLA, construction jobs, and other livelihood diversification options. However, as 75% farmers involved in this study were not lettered,

they could not keep records of their farm earnings and those from other sources so as to provide evidence to their claims.

### **5.7 Challenges Farmers Faced in Accessing Institutional Support**

Findings of the study indicated that, respondents encountered barriers in their attempt to receive institutional support (Fig. 9). The barriers stated by the respondents in Table 10 fit directly into the conceptual framework and the findings of Moser and Ekstrom (2010) and (Jantarassami *et al.*, 2010) on barriers the institutional and cultural barriers to climate change.

Moser and Ekstrom (2010) identified institutional, environmental and socio-cultural barriers affecting adaptation to climate change. Language could fit as an environmental barrier while education, poverty could be defined as socio-cultural barriers (Moser and Ekstrom, 2010). Also, though respondents did not mention any cultural barriers, it was deduced from the institutional interviews that, interventions to climate change particularly provision of women farmers with sheep and goats was against the Sissala cultural norms. This traditional practice could have had the tendency of barring women from that particular intervention.

Respondents stated trust as a barrier affecting their access to institutions (Table 13). It can be deduced from field observation that, trust falls under behavioural barriers as it results from behavioural traits of the individual farmer. While informational barriers can be classified as both institutional and socio-cultural, in the case of this study, the farmers ascribed informational barriers as an institutional barrier. The respondents explained their reason for ascribing informational barriers to institutions was as a result of their ignorance about the existence of some of the institutions. This then makes it difficult for

them to approach the institutions or offer a hand in their activities as cited by Jantarassami *et al.*, 2010. Furthermore, discussions with respondents confirmed the findings of Fosu-Mensah *et al.* (2012) that lack of information on the right adaptation strategies and weather conditions as barriers that affected their adaptation.

### **5.8 Problems institutions face in providing support to farmers**

As identified elsewhere by Moser and Ekstrom (2010) Jantarassami *et al.* (2010), Measham *et al.* (2011) and the conceptual framework, institutions in the study districts also faced some form of challenges in the process of offering adaptation support to smallholder farmers. Excerpts of interviews held with institutions presented in Section 4.10 shows that, institutions identified two groups of barriers that affected their ability to provide adaptation support to smallholder farmers.

As discovered by earlier studies Moser and Ekstrom (2010), Measham *et al.* (2011) and IPCC (2013), institutions involved in the study faced challenges in providing adaptation support which they described arise from the structure of their organizations from within the institutions themselves which affects their efforts at addressing climate change. These are factors that arise from within the institutions and those that arise as a result of actions of the smallholder farmer such as lack of finance and trained human resources (Section 4.10).

### **5.9 Improving the linkages between Institutions and Smallholder Farmers**

Respondents of the study were given the opportunity to suggest ways the gap between farmers and institutions can be bridged so as to increase their rate of access to support. From the results of analysis presented in Table 14, respondents called for institutions to employ more officials who could speak and understand their local language and also

expand their offices to other locations district wide. These responses from the field relate to the findings of Daressa *et al.* (2009) especially since institutions will stand to employ more people in their bid to reach more people. In contrast to the findings of others studies, respondents of this study called for provision of extensive information on the existence of institutions and types of support adaptation support they provide and processes farmers must go through to access the support. Also this study also identified that, one peculiar issue that hinders their access to institutional support as communications and therefore called for employment of indigenes by institutions.

### **5.10 Summary**

Within this chapter, findings of the study were discussed based on the research objectives. The main findings of the study showed that there is a significant influence of institutional support on smallholder farmer adaptation. Again, study outcomes indicated that both institutions and farmers faced challenges in providing and receiving institutional support.

## CHAPTER 6

### SUMMARY, CONCLUSION AND RECOMMENDATIONS

#### 6.1 Chapter Outline

This chapter presents the summary, conclusion and recommendations of the entire study. The chapter opens with a summary of the findings of the study and closes with some recommendations.

#### 6.2 Summary of Findings

The main finding of the study was that, institutional support has a significant effect on climate change adaptation in the two districts. The smallholder farmers mentioned that, the result of institutional support to adaptation manifests as an increase in productivity, a decrease in the number of migrants out of the area and also, a general improvement in their well-being.

Furthermore, study also found out that, in line with objectives two and three, both institutions and individuals faced challenges in their efforts to give and receive adaptation support as cited by Moser and Ekstrom (2010) and Jones (2010). These barriers may arise from the smallholder farmers themselves or may be as a result of institutional failures. The study findings further indicated that, barriers that arise from the smallholder farmers are behavioural and socio-cultural as described by Nielson and Reenberg (2010); Moser and Ekstrom (2010); Jones, (2010). Barriers that arise from the institutions themselves may be as a result of structural processes and organizational decisions which may result in issues such as lack of finance, human resources and lack of understanding between

institutions offering adaptation (Jantarassami *et al.*, 2010; Measham *et al.*, 2011; Pradhan *et al.*, 2012). These problems may result in competition and undue conflicts amongst institutions that offer adaptation support to smallholder farmers.

Additionally, the study showed that age and gender did not affect smallholder farmers' access to institutional support as exposed by Etwire *et al.* (2013) and Deressa *et al.* (2009). Rather, what determined whether males or females will receive institutional support in the study districts was the kind of support being introduced and the viability of the individual to receive the needed support.

Again, the study found that smallholder farmers in the two districts have developed their own strategies with which they adapt to climate change independent of institutions (Daressa *et al.*, 2009, Ngigi *et al.*, 2009; Stanturf *et al.*, 2011). However, the study also found that, institutions which offered adaptation support developed and improved upon the strategies individuals and households have established over the years, in order to prevent mal-adaptation as cited by Agrawal (2008). The study observed that, there is the need for institutions to identify, and introduce modern and innovative techniques of adaptation which will aid successful adaptation to the fast anthropogenic change as is now being experienced based on the adaptation needs of the society.

Lastly, the study found that, formal institutions are making efforts to change negative cultural traditions that hinder a successful adaptation procedure. In the Sissala East District for example, the District Assembly together with other institutions have been able to introduce animal rearing amongst women which was against the Sissala tradition.

### 6.3 Conclusion

The study sought to find out the effectiveness of institutional support to the adaptation of smallholder farmers to climate change. The impacts of climate change on economic sectors are real and smallholder farming is one of the most vulnerable sectors to climatic change (IPCC, 2013). This is a major concern since smallholder farmers form the largest employment group worldwide and the major staple food producer (ILO, 2014; FAO, 2012). Consequently, adaptation of smallholder farmers to climate change is needed to ensure the sustainability of their livelihoods and to safeguard food security. Institutions have been identified to play important roles in adaptation as they shape the response and strategies households adopt to reduce the impacts of climate change (Agrawal *et al.*, 2010).

In order to measure the effectiveness of institutional support on smallholder farmer adaptation, the study took a sample of 160 smallholder farmers and 12 heads of institutions involved in agricultural development in the Sissala East and West Districts in the Upper West Region of Ghana. Information was sought about impact of institutional support, the challenges institutions and farmers face in giving or receiving support among others. Results collected from the field was analysed with SPSS and content analysis.

The study findings indicated that, the knowledge and perception of climate change in the study area was high as both smallholder farmers and institutions were aware of its impacts which they described to have both agricultural and non-agricultural effects as stated by Morton (2007). Again, the study findings indicated that, despite the high knowledge of climate change by smallholder farmers in the study area, not all of them

had taken up strategies to reduce the impacts of climate change on their farming activities.

Further the study showed that, institutional support provided to farmers to address the impacts of climate change is successful though the study could not validate the responses of farmers as most of them were unlettered and therefore kept no records. Also in line with objective two of the study, outcomes indicate that farmers faced challenges in accessing institutional support which arose from lack of information, language barriers and poverty to mention a few. Again, the study found that, institutional challenges to offering climate change adaptation support may arise from either the structural and organizational decisions which may result in low human resources and finance, from character traits of the people whom the institution wishes to support (such as low financial commitment to pay for support, apathy to adaptation projects) or from social norms operating in the district.

#### **5.4 Recommendations**

Based on the findings discussed above, the study came out with a number of recommendations in order to improve institutions access to smallholder farmers and vice-versa and also for policy formulation and implementation. These recommendations are discussed below:

Considering the dispersed distribution of population in the study areas together with the poor nature of roads, the study suggest that institutions involved in adaptation at the district level should develop innovative ways of meeting with smallholder farmers in remote parts of the districts. This could be done through outreach services on specific

days that would be convenient to the people such as market days when people from the remote parts of the districts come to trade. Again, institutions involved in the adaptation process must employ more local people so as to enhance effective communication between the institutions and the smallholder farmers. Based on this recommendation, District Assemblies, MP's and other opinion leaders in the districts should encourage the people to take advantage of the Free Compulsory Universal Basic Education (FCUBE) Programme to ensure that, their wards are properly educated to make them eligible to apply for positions when they are available.

The Government, private sector and other stakeholders should come together to draw a plan on how irrigation on River Kulpawn (in Sissala West) and the Sisili River valley (in Sissala East) will be developed to aid farmers adapt to climate change while also ensuring smallholder farmer productivity all year round as was proposed in Food and Agricultural Sector Policy Development Policy (FASDEP) II.

The study further recommends that, institutions and opinion leaders must work together to educate the people on the importance of paying for certain services to ensure that their productivity increases in this period of climatic changes. This call comes as a result of the study observing that, farmers generally understood institutional support to mean those which come freely from institutions. During the data collection, it was observed that, most of the farmers considered institutional support to include only support which comes freely. However, some of the institutions provide these services at a cost which the farmers do not consider as support. Education is particularly important as funding sources for projects and NGO's get scarcer by the year.

Lastly, there is the need for a policy by government and institutions to ensure sustainability of interventions towards smallholder adaptation. Institutions which offer adaptation support to smallholder farmers must ensure the sustainability of interventions they introduce to farmers as opposed to what happens in most cases where when a particular project run by an institution is ended, the institutional surveillance for the intervention also comes to an end. This creates difficulties for smallholder farmers to continue with the particular interventions. This is especially true in the case of NGO's and public organizations. If they could charge beneficiaries of such interventions a token to ensure project sustainability, it would go a long way to increase the productivity of farmers. Again, institutions could budget for sustainability content in adaptation projects which can be used to ensure the durability of projects they introduce to smallholder farmers.

## REFERENCES

- Abdulai, A. and CroleRees, A. (2001). Determinants of Income Diversification amongst Rural Households in Southern Mali. *Food Policy*, 26, 437–452. Retrieved September 22, 2014, from <http://www.sciencedirect.com/science/article/pii/S0306919201000136>
- Adger, W. N., Huq, S., Brown, K., Conway, D., & Hulme, M. (2003). Adaptation to climate change in the developing world. *Progress in development studies*, 3(3), 179-195. Retrieved April 20, 2014 from <http://pdj.sagepub.com/content/3/3/179.full.pdf>
- Advanced Training Programme on Humanitarian Action (ATPHA) (2014). *Home. Thematic Areas. Sustainable Livelihoods Framework*. Retrieved April 2, 2014, from ATHA. Advanced Training Programme on Humanitarian Action: <http://www.atha.se/thematic-areas/sustainable-livelihoods-framework>
- Agrawal, A. (2010). The Role of Local Institutions in Climate Change Adaptation. In T. W. Bank, and R. M. Norton (Eds.), *Social Dimensions of Climate Change* (pp. 173-197). Washington DC, USA: World Bank.
- Agrawal, A., McSweeney, C. and Perrin, N. (2010). *Local Institutions and Climate Change Adaptation*. World Bank Social Development Notes 113. Retrieved March 12, 2014, from, [http://siteresources.worldbank.org/EXTSOCIALDEVELOPMENT/Resources/244362-1164107274725/31823701164201144397/Local\\_InstitutionsClimate\\_Change\\_Adaptation\\_note113.pdf%3Fresourceurlname=Local\\_Institutions-Climate\\_Change\\_Adaptation\\_note113.pdf](http://siteresources.worldbank.org/EXTSOCIALDEVELOPMENT/Resources/244362-1164107274725/31823701164201144397/Local_InstitutionsClimate_Change_Adaptation_note113.pdf%3Fresourceurlname=Local_Institutions-Climate_Change_Adaptation_note113.pdf)
- Agrawal, A. and Perrin, N. (2008). *Climate Adaptation, Local Institutions and Rural Livelihoods*. Michigan: International Forestry Resource and Institutions Programme
- Altieri, M. A., and Koohafkan, P. (2008). *Enduring Farms: Climate Change, Smallholders and Traditional Farming Communities*. Penang, Malaysia: Third World Network. Retrieved February 10, 2014, from [http://sa.indiaenvironmentportal.org.in/files/Enduring\\_Farms.pdf](http://sa.indiaenvironmentportal.org.in/files/Enduring_Farms.pdf)
- Amaratunga, D., Baldry, D., Sarshar, M. and Newton, R. (2002). Quantitative and qualitative research in the built environment: application of “mixed” research approach. *Work study*, 51(1), 17-31.
- Amikuzunu, J. and Donkoh, S. A. (2012). Climate variability and yields of major staple food crops in Northern Ghana. *African Crop Science Journal*, 20(2), 349-360. Retrieved September 22, 2014, from <http://www.ajol.info/index.php/acsj/article/view/81668/71818>
- Asmah, E. E. (2011). Rural Livelihood Diversification and Agricultural Household Welfare in Ghana. *Journal of Development and Agricultural Economics*, 3(7),

325-334 Retrieved November 1, 2014 from  
[http://www.academicjournals.org/article/article1379517769\\_Asmah.pdf](http://www.academicjournals.org/article/article1379517769_Asmah.pdf)

- Beddington, J., Asaduzzaman, M., Clark M., Fernández A., Guillou M., Jahn M., Erda L., Mamo T., Van Bo N., Nobre C. A., Scholes R., Sharma R and Wakhungu J. (2012). *Achieving Food Security in the Face of Climate Change: Final report from the Commission on Sustainable Agriculture and Climate Change*. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. Available online at: [www.ccafs.cgiar.org/commission](http://www.ccafs.cgiar.org/commission)
- Belden, C. (2010). *Examining relationships between customary and state institutions in Ghana's decentralized system* (No. 1030). International Food Policy Research Institute (IFPRI). Retrieved December 10, 2014, from <http://www.ifpri.cgiar.org/sites/default/files/publications/ifpridp01030.pdf>
- Birthal, P. S. and P. K. Joshi. 2009. *Smallholder farmers' access to markets for high-value agricultural commodities in India*. In Case Studies in Food Policy for Developing Countries. Pinstrop-Andersen P. and Cheng F., eds. Ithaca, NY: Cornell University Press.
- Bondinuba, F. K. (2012). Exploring the Challenges and Barriers in Accessing Financial Facilities by Small and Medium Construction Firms in Ghana. *Civil and Environmental Research*, 2(6), 25-35. Retrieved December 11, 2014, from <http://www.iiste.org/Journals/index.php/CER/article/download/2435/2668>
- Brooks, N., Adger, W. and Mick Kelly, P. (2005). The determinants of vulnerability and adaptive capacity at the national level and the implications for adaptation. *Global environmental change*, 15(2), 151-163. Retrieved April, 10, 2014, from, <http://intranet.catie.ac.cr/intranet/posgrado/BB507%20Cambio%20Global/Documentos/2013/lecturas/Brooks%202005%20Determinants%20of%20national%20vulnerability%20and%20adaptive%20capacity.pdf>
- Crabbé, P. and Robin, M. (2006). Institutional Adaptation of Water Resource Infrastructures to Climate Change in Eastern Ontario. *Climatic Change*, 78(1), 103-133. Retrieved April 10, 2014, from [http://www.schusterweb.com/ISEE/papers/8241\\_CrabbeP.doc](http://www.schusterweb.com/ISEE/papers/8241_CrabbeP.doc)
- Collier, P. and Dercon, S. (2009). *African agriculture in 50 years: Smallholders in a rapidly changing world*. Paper Presented at the Expert Meeting on How to Feed the World in 2050. Rome: Food and Agriculture Organization of the United Nations. Retrieved August 3, 2014, from <http://www.sciencedirect.com/science/article/pii/S0305750X13002131>
- Cooper, P. J. M., Dimes, J., Rao, K. P. C., Shapiro, B., Shiferaw, B. and Twomlow, S. (2008). Coping better with current climatic variability in the rain-fed farming systems of sub-Saharan Africa: an essential first step in adapting to future climate change? *Agriculture, Ecosystems and Environment* 126, 24 –35.

- Cotula, L. and Chauveau, J. P. (2007). *Changes in customary land tenure systems ion Africa*. lied.
- Cotula, L., Dyer, N., and Veremeulen, S (2008). *Fuelling Exclusion?: The Biofuels Boom and Poor People's Access to Land*. lied.
- Darko, E. and Atazona, L. (2013). Literature Review on the Impact of Climate Change on Economic Development in Northern Ghana - Challenges and Opportunities. EPS PEAKS, UK (2013).
- Deressa, T. T., Hassan, R. M, Ringler C., Alemu T. and Yesuf M. (2009). Determinants of Farmers' Choice of Adaptation Methods to Climate Change in the Nile Basin of Ethiopia. *Global Environmental Change*. 19, 248-255. Retrieved May 5, 2014, from [http://www.dspace.up.ac.za/bitstream/handle/2263/9270/Deressa\\_Determinants\(2009\).pdf?sequence=1](http://www.dspace.up.ac.za/bitstream/handle/2263/9270/Deressa_Determinants(2009).pdf?sequence=1)
- Dixit, A., Upadhyaya, M., Dixit, K., Pokhrel, A. and Rai, R. (2009). *Living with Water Stress in the Hills of the Koshi Basin, Nepal*. International Centre for Integrated Mountain Research (ICIMOD), Nepal.
- Du Plessis, J. (2005). The growing problem of forced evictions and the crucial importance of community-based, locally appropriate alternatives. *Environment and Urbanization*, 17(1), 123-134.
- Ellis, F. (1998). Household strategies and Rural Livelihood Diversification. *Journal of Development Studies*, 35 (1) (1998), pp. 1–38. Retrieved March 17, 2014, from, <http://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/4486/40-rural-livelihood-diversity.pdf?sequence=1>
- Ellis, F. (2000). The Determinants of Rural Livelihood Diversification in Developing Countries. *Journal of Agricultural Economics*, 51: 289–302. doi: 10.1111/j.1477-9552.2000.tb01229.x. Retrieved March 17, 2014, from <http://onlinelibrary.wiley.com/doi/10.1111/j.1477-9552.2000.tb01229.x/pdf>
- Eriksen, S., and Selboe, E. (2012). The Social Oganisation of Adaptation to Climate Variability and Global Change: The Case of a Mountain Farming Community in Norway. *Applied Geography*, 159-167. Retrieved July 25, 2014, from <http://www.sciencedirect.com/science/article/pii/S0143622811001809>
- Etwire, P.M., Al-Hassan R.M., Kuwornu, J.K.M., Osei-Owusu, Y. (2013). Smallholder Farmers' Adoption of Technologies for Adaptation to Climate Change in Northern Ghana. *Journal of Agricultural Extension and Rural Development*, 5(6), 121-129. Retrieved August 15, 2014, from <http://www.academicjournals.org/journal/JAERD/article-full-text-pdf/47931995619>
- Food and Agricultural Organiation. (2001). *Farming Systems and Poverty*. (T. C. Department, Ed.) Retrieved July 27, 2014, from <http://www.fao.org/DOCREP/004/AC349E/AC349E00.HTM>.

- Food and Agricultural Organization. (2003). *Unlocking the Water Potential of Agriculture*. Retrieved July 27, 2014, from <http://www.fao.org/DOCREP/006/Y4525E/Y4525E00.HTM>
- Food and Agricultural Organization. (2011). *The State of Food Security in the World. How Does International Price Volatility Affect Domestic Economies and Food Security*. Retrieved September 14, 2014, from <http://www.fao.org/docrep/014/i2330e/i2330e.pdf>
- Food and Agricultural Organization. (2012). *Investing in Smallholder Agriculture for Food and Nutrition Security*. Retrieved February 14, 2014, from [www.fao.org/fsnforum/sites/default/files/files/85-smallholders-v0/HLPE\\_V0draft-nInvesting in SH - 20-12-2012.pdf](http://www.fao.org/fsnforum/sites/default/files/files/85-smallholders-v0/HLPE_V0draft-nInvesting%20in%20SH%20-%2020-12-2012.pdf) *Institutions and Environmental Change: Principal Findings, Applications and Research Frontiers*, edited by OR Young, LA King and H. Schroeder, 187-224.
- Fosu-Mensah, P. L. G. Vlek, D. S. MacCarthy, 2012. Farmers' Perception and Adaptation to Climate Change: A Case Study of Sekyedumase District in Ghana. *Environment, Development and Sustainability*. 14:4, 495-505. Retrieved September 18, 2014, from <http://www.tropentag.de/2010/abstracts/full/203.pdf>.
- Gehring, T., and Oberthür, S. (2008). *Interplay: Exploring institutional interaction*.
- Ghana (1992). *Constitution of the Republic of Ghana*. Tema: Ghana Publishing Corporation.
- Ghana Statistical Service (GSS). (2012). *2010 Population and Housing Census Final Results*. Accra: Ghana Statistical Service.
- Gortner, H., Nichols, K. and Ball, C. (2007). *Organization Theory: A public and Non-Profit Perspective*. Belmont, California, USA: Wadsworth Thomson Learning.
- Hall, A., Mytelka, L. and Oyeyinka, B. (2006). *Concepts and Guidelines for Diagnostic Assessments of Agricultural Innovation Capacity*. Maastricht: United Nations University, Maastricht, Netherlands.
- Hall, A.J., Clark, N. and Naik, G. (2007). Technology Supply Chain or Innovation Capacity? Contrasting Experiences of Promoting Small-Scale Irrigation Technology in South Asia. *International Journal of Technology Management and Sustainable Development*, 6 (2), 77-101.
- Harmeling, S., Kreft, S. and Rai, S. C. (2011). *Institutions for adaptation: towards an effective multi-level interplay*. Germanwatch eV, Office Bonn, Bonn, Germany and World Wide Fund for Nature (WWF) International, Gland, Switzerland.
- Harvey A., C., Rakatobe, L. Z., Rao, S. N., Dave, R., Razafimahatratra, H., Rabarijohn, H. R., Rajaofara, H., and MacKinnon J. L. (2014). Extreme Vulnerability of Small Holder Farmers to Agricultural Risks and Climate change in Madagascar. *Philosophical Transactions of the Royal Society B369: 20130089*, 1-12.

- Hassan R. and Nhemachena C. (2008). Determinants of African farmers' Strategies for Adapting to Climate Change: Multinomial Choice Analysis. *African Journal of Agricultural and Resource Economics*, 2 (1), 83-104. Retrieved April 10, 2014, from [http://www.afjare.org/resources/issues/vol\\_2\\_no1/5%20Hassan%20%26%20Nhemachena%20%20Determinants%20of%20African%20farmers%E2%80%99%20strategies.pdf](http://www.afjare.org/resources/issues/vol_2_no1/5%20Hassan%20%26%20Nhemachena%20%20Determinants%20of%20African%20farmers%E2%80%99%20strategies.pdf)
- Hisali, E., Birungi, P. and Buyiza, F. (2010). Adaptation to climate change in Uganda: evidence from micro level data. *Global Environmental Change*, 21(4), 1245-1261.
- Hussein, K. and Nelson, J., 1998. Sustainable Livelihoods and Livelihood Diversification. IDS Working Paper 69, Institute of Development Studies, Sussex. Retrieved August 28, 2014, from <https://www.ids.ac.uk/files/Wp69.pdf>
- Howden, S. M., Soussana, J. F., Tubiello, F. N., Chhetri, N., Dunlop, M. and Meinke, H. (2007). Adapting agriculture to climate change. *Proceedings of the National Academy of Sciences*, 104(50), 19691-19696. Retrieved November 30, 2014, from <http://www.pnas.org/content/104/50/19691.long>
- Institute of Democratic Governance, Ghana (IDG). (2010). The Role of CSOs in Ghana's Decentralization Reform. *Governance Newsletter*, 1(1). Accra, Ghana.
- Intergovernmental Panel on Climate Change (IPCC). (2013). *Climate Change 2014: Impacts, Adaptation and Vulnerability. Summary for Policy Makers. Contribution of Working Group 1 to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, UK.
- International Labour Organization (ILO). (2014). *Trade and Employment >> Shared Harvests, Trade and Employment (ILO-UNCTAD)*. Retrieved March 7, 2014, from International Labour Organization: <http://www.ilo.org/global/industries-and-sectors/agriculture-plantations-other-rural-sectors/lang-en/index.html>
- Jantarassami, L., Lawler, J. and Thomas, C. (2010). Institutional Barriers to Climate Change Adaptation in U.S National Parks and Forests. *Ecology and Society*, 15(4). Retrieved August 23, 2014, from <http://www.ecologyandsociety.org/vol15/iss4/art33/>
- Jayne T.; Mather, D. and Mghenyi, D. (2010). Principal Challenges Confronting Smallholder Agriculture in Sub-Saharan Africa. *World Development* 38 (10). 1384–98. Retrieved August 17, 2014, from <ftp://ftp.cgiar.org/ilri/ICT/Theme%203/ACIAR%20pig%20proposal/policy%20advocacy/principal%20challenges%20confronting%20smallholder%20agri%20africa.pdf>
- Jones, L. (2010). Overcoming Social Barriers to Adaptation. Overseas Development Institute, London (2010). Retrieved August 23, 2014, from: <http://www.odi.org.uk/resources/download/4945.pdf>
- Jones, L. and Boyd, E. (2011). Exploring social barriers to adaptation: Insights from Western Nepal. *Global Environmental Change*, 21(4), 1262-1274. Retrieved

August 23, 2014, from <http://www.sciencedirect.com/science/article/pii/S0959378011000860>

- Kalame, F. B., Nkem, J., Idinoba, M. and Kanninen, M. (2009). Matching national forest policies and management practices for climate change adaptation in Burkina Faso and Ghana. *Mitigation and Adaptation Strategies for Global Change*, 14(2), 135-151.
- Kalame, F. B., Aidoo, R., Nkem, J., Ajayie, O. C., Kanninen, M., Luukkanen, O. and Idinoba, M. (2011). Modified taungya system in Ghana: a win-win practice for forestry and adaptation to climate change?. *Environmental Science & Policy*, 14(5), 519-530.
- Kasei, R.A., Ampedu, B. and Yallevu S. (2014). Impacts of Climate Variability on Food Security in the Northern Region. *Journal of Earth Sciences and Geotechnical Engineering*. 4(3)47-5. ISSN:1792-9660 (online).
- Kelly, P. M. and Adger, W. N. (2000). Theory and practice in assessing vulnerability to climate change and facilitating adaptation. *Climatic change*, 47(4), 325-352. Retrieved August 17, 2014, from <http://nome.colorado.edu/HARC/Readings/Kelly.pdf>
- Kemausuor, F., Dwamena, E., Bart-Plange, A. and Kyei-Baffour, N. (2011). Farmers perception of climate change in the Ejura-Sekyedumase district of Ghana. *ARNP Journal of Agricultural and Biological Science*, 6(19), 26-37. Retrieved September 22, 2014, from [http://www.arnpjournals.com/jabs/research\\_papers/rp\\_2011/jabs\\_1011\\_321.pdf](http://www.arnpjournals.com/jabs/research_papers/rp_2011/jabs_1011_321.pdf)
- Koku, J. E. and Gustafsson, J. E. (2003). Local institutions and natural resource management in the South Tongu district of Ghana: a case study. *Sustainable Development*, 11(1), 17-35. Retrieved February 15, 2014, from <http://sanrem.cals.vt.edu/1048/Local%20institutions%20and%20NRM%20in%20Tongu%20Dist.pdf>
- Kranjac-Berisavljevic, G., Blench, R.M., Bayorbor, T. B., Turton, C. N., Abdulai, A. S., Boyd, C., Obeng, F. and Drake, E. (1999). *Rethinking natural resource degradation in semi-arid sub-Saharan Africa: The case of semi-arid Ghana*. London, Overseas Development Institute, Retrieved September 23, 2014, from [http://www.odi.org.uk/rpeg/soil\\_degradation/ghlit.pdf](http://www.odi.org.uk/rpeg/soil_degradation/ghlit.pdf).
- Kundzewicz, Z. W. and Mata, L. J. (2007). Freshwater Resources and their Management, Chapter 3 in: Climate Change 2007. Impacts, Adaptation, and Vulnerability, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.
- Kusakari Y., Owusu Asubonteng, K., Seidu Jasaw, G., Dayour, F., Dzivenu, T., Lolig, V., Donkoh, S. A., Obeng, F. K., Gandaa, B. and Kranjac-Berisavljevic, G. (2014). Farmer-Perceived Effects of Climate Change on Livelihoods in Wa West District, Upper West Region of Ghana. *Journal of Disaster Research* 07/2014.

- 9(4), 516-528. Retrieved September 23, 2014, from [http://www.researchgate.net/profile/Kwabena\\_Asubonteng/publication/265471160\\_FarmerPerceived\\_Effects\\_of\\_Climate\\_Change\\_on\\_Livelihoods\\_in\\_Wa\\_West\\_District\\_Upper\\_West\\_Region\\_of\\_Ghana/links/541000250cf2f2b29a3df6ac.pdf](http://www.researchgate.net/profile/Kwabena_Asubonteng/publication/265471160_FarmerPerceived_Effects_of_Climate_Change_on_Livelihoods_in_Wa_West_District_Upper_West_Region_of_Ghana/links/541000250cf2f2b29a3df6ac.pdf)
- Laube, W., Schraven, B., and Awo, M. (2012). Smallholder adaptation to climate change: dynamics and limits in Northern Ghana. *Climatic change*, 111(3-4), 753-774. Retrieved September 22, 2014, from [http://www.zef.de/fileadmin/media/news/77ac\\_laube-schraven-awo\\_smallholder\\_adaption.pdf](http://www.zef.de/fileadmin/media/news/77ac_laube-schraven-awo_smallholder_adaption.pdf)
- Lobell, D. B., Schlenker, W. and Costa-Roberts, J. (2011). Climate Trends and Global Crop Production Since 1880. *Science*, 616-620.
- M'Cormack, F. (2011). *Sustainable Livelihood Highlights. Research Findings for Development Policymakers and Practitioners*. Institute of Development Studies. Brighton, UK: IDS Knowledge Services.
- Maddison, D. (2007). *The Perception of and Adaptation to Climate Change in Africa*. World Bank. World Bank.
- Marchetta, F., (2008). Smallholder adaptation to climate change: dynamics and limits in Northern Ghana. *Climatic Change*, 111(3-4), 753-774. Retrieved September 22, 2014, from [http://www.disei.unifi.it/upload/sub/pubblicazioni/repec/pdf/wp16\\_2008.pdf](http://www.disei.unifi.it/upload/sub/pubblicazioni/repec/pdf/wp16_2008.pdf)
- Magombo, M. T., Kanthiti, G., Phiri, G., Kachulu, M. and Kabuli, H. (2012). *Incidence of Indigenous, Emerging and Innovative Climate Change Adaptation Practices for Smallholder Farmers' Livelihood Security in Chikhwawa District, Southern Malawi*. African Technology Policy Studies Network. Nairobi, Kenya: African Technology Policy Studies Network.
- Mathison, S. (1988). Why Triangulate. *Educational Researcher*, 17(2), 13-17.
- Mayers, J., Howard, C., Nii Ashie Kotey, E., Prah, E. and Richards, M., 1996. *Incentives for Sustainable Forest Management: A Study in Ghana*. International Institute for Environment and Development, and Forestry Department of Ghana.
- Measham, T. G., Preston, B. L., Smith, T. F., Brooke, C., Gorrdard, R., Withycombe, G. and Morrison, C. (2011). Adapting to climate change through local municipal planning: barriers and challenges. *Mitigation and Adaptation Strategies for Global Change*, 16(8), 889-909.
- Ministry of Food and Agriculture (MoFA). (2007). *Food and Agriculture Sector Development Policy*. Retrieved March 26, 214, from Ministry of Food and Agriculture, Ghana: [http://MoFA.gov.gh/site/?page\\_id=598](http://MoFA.gov.gh/site/?page_id=598)
- Ministry of Food and Agriculture (MoFA). (2013a). *Sissala East*. Retrieved April 22, 2014, from Ministry of Food and Agriculture, Republic of Ghana. Retrieved January 23, 2010, from [http://MoFA.gov.gh/site/?page\\_id=1679](http://MoFA.gov.gh/site/?page_id=1679)

- Ministry of Food and Agriculture (MoFA). (2013b). *Sissala West*. Retrieved April 22, 2014, from Ministry of Food and Agriculture, Republic of Ghana. Retrieved January 23, 2010, from [http://MoFA.gov.gh/site/?page\\_id=1681](http://MoFA.gov.gh/site/?page_id=1681)
- Ministry of Local Government and Rural Development and Moks Publications and Media Service. (2006a). *Upper West>> Sissala West District*. Retrieved April 22, 2014, from Ghana Districts: [http://ghanadistricts.com/districts/?r=9and\\_=113anda=1348](http://ghanadistricts.com/districts/?r=9and_=113anda=1348)
- Ministry of Local Government and Rural Development and Moks Publications and Media Services. (2006b). *Upper West>> Sissala East*. Retrieved April 22, 2014, from Ghana Districts: [http://ghanadistricts.com/districts/?r=9and\\_=113andsa=1351](http://ghanadistricts.com/districts/?r=9and_=113andsa=1351)
- Mitchell, T. and Tanner, T.M. (2006). *Adapting to Climate Change: Challenges and Opportunities for the Development Community*. Teddington : Tearfund.
- Mortimore M. J. and Adams W. M. (2001). Farmer Adaptation, Change and ‘Crisis’ in the Sahel. *Global Environmental Change-Human and Policy Dimensions*. 11: 49–57. Retrieved August 22, 2014, from <http://www.sciencedirect.com/science/article/pii/S0959378000000443>
- Morton, F. J. (2007). The Impact of Climate Change on Smallholder and Subsistence Agriculture. *PANS (Proceedings of the National Academy of Sciences of the United States)*, 104(50).
- Moser, C. and Satterthwaite, D. (2010). Toward Pro-Poor Adaptation to Climate Change in the Urban Centers of Low and Middle Income Countries. Equity and Vulnerability in a Changing World. In W. Bank, and R. M. Norton (Ed.), *Social Dimaentions of Climate Change* (pp. 231-258). Washington D.C: World Bank.
- Moser, S. C. and Ekstrom, J. A. (2010). A Framework to Diagnose Barriers to Climate Change Adaptation. *Proceedings of the National Academy of Sciences of the United States of America (PNAS)*, 22020-22031.
- Mukheibir, P. and Ziervogel, G. (2007). Developing a Municipal Action Plan (MAP) for Climate Change: The City of Cape Town. *Environment and Urbanization* 19 (1) 143–58.
- Munasinghe, M. (2001). *Exploring the Linkages between Climate Change and Sustainable Development: A Challenge for Transdisciplinary Research*. Retrieved March 5, 2014, from Ecology and Society: <http://www.consecol.org/vol5/iss1/art14/>
- Musah-Surugu, J. I. and Ahenkan, A. (2014). Rising to the Challenge: What sort of capacity does Ghana need to Adapt to Climate Change?. *Ethiopian Journal of Environmental Studies and Management*, 7(1), 780-789. Retrieved December 10, 2015 from <http://www.ajol.info/index.php/ejesm/article/viewFile/110450/100193>
- Nadeem S, Elahi, I., Hadi, A. and Uddin, I. (2012). *Traditional knowledge and local institutions support adaptation to water-induced hazards in Chitral, Pakistan*.

- Report, International Centre for Integrated Mountain Development (ICIMOD), Nepal. Nadeem, S., Elahi, I., Hadi, A., and Uddin, I. (2012). Traditional knowledge and local institutions support adaptation to water-induced hazards in Chitral, Pakistan.
- NADMO (2012). National Disaster Management Assessment Report, 2012.
- Nigigi, S. N. (2009). *Climate Change Adaptation Strategies. Water Resource Management Options for Small Holder Farming Systems in Sub-Saharan Africa*. New York: The MDG Centre for East and Southern Africa of the Earth Institute at Columbia University.
- Nielsen, J. Ø. and Reenberg, A. (2010). Cultural Barriers to climate change adaptation: A case study from Northern Burkina Faso. *Global Environmental Change* 20(1), 142-152.
- North, D.C. (1990). *Institutions, Institutional Change and Economic Performance*. Cambridge: The Press Syndicate of the University of Cambridge.
- O'Brien, K. L. and Leichenko, R. M. (2000). Double exposure: Assessing the Impacts of Climate Change within the Context of Economic Globalization. *Global Environmental Change*, 10, 221-232.
- O'Riordan T. and Jordan, A. (1999). Institutions, Climate Change and Cultural Theory: Towards a Common Analytical Framework. *Global Environmental Change*, 9(2), 81-93. Abstract Retrieved August 17, 2014 from <http://www.sciencedirect.com/science/article/pii/S0959378098000302>
- Ofori-Sarpong E. and Asante (2008) in Altieri, M. A., and Koohafkan P. (2008). *Enduring Farms: Climate Change, Smallholders and Traditional Farming Communities*. Penang, Malaysia: Third World Network.
- Ostrom, E. (2009). *Understanding institutional diversity*. Princeton university press.
- Owusu, K. and Waylen, P. (2009). Trends in Spatio-Temporal Variability in Annual Rainfall in Ghana (1951-200). *Weather*, 115-120
- Penalba, M. L., Elazegui, D. D. and Pulhin, M. J. (2012). Social and Institutional Dimensions of Climate Change Adaptation. *International Journal of Climate Change Strategies and Management*, 4(3), 308-322. Retrieved August 17, 2014, from <http://www.emeraldinsight.com/doi/pdfplus/10.1108/17568691211248748>
- Piya, A., Yogesh, V., Phillipp, K., Tim, F., Melissa, H., Paul, S., et al. (2003). Poverty and Climate Change. Reducing the Vulnerability of the Poor Through Adaptation. (S. Frank, Ed.)
- Population Action International. (2011). *Why Population Matters to Food Security*. Washington DC, USA.

- Pradhan, N. S., Khadgi, V.R., Schipper, L., Kaur, N., and Geoghegan, T. (2012) *Role of Policy and Institutions in Local Adaptation to Climate Change – Case studies on responses to too much and too little water in the Hindu Kush Himalayas*. Kathmandu: ICIMOD
- Rahman, A. (2008). *Climate Change and the Future of Smallholder Agriculture. How can rural poor people be a part of the solution to climate change?* IFAD Policy Reference Group on Climate Change, 12 p.
- Rajalahti, R. (2012). Sourcebook Overview and User Guide. I World Bank Agricultural Innovation Systems. An Investment Sourcebook.
- Rodima-Taylor, D., Olwig, M. F. and Chhetri, N. (2011). Adaptation as Innovation, Innovation as Adaptation: An Institutional Approach to Climate Change. *Applied Geography*. Retrieved July 15, 2014, from, <http://crsps.net/wp-content/downloads/Livestock-Climate%20Change/Inventoried%2012.3/12-2011-4-35.pdf>
- Rosenzweig, C. and Parry, M. L. (1994). Potential Impact of Climate Change on World Food Supply. *Nature*, 367(6459), 133-138. Retrieved July 10, 2014, from <http://ecoethics.net/cyprus-institute.us/PDF/Rosensweig-Food-Supply.pdf>
- Scoones, I. (2009). Livelihood Perspectives and Rural Development. *The Journal of Peasant Studies*, 171-196. Retrieved April 3, 2014, from <http://www.tandfonline.com/doi/full/10.1080/03066150902820503>
- Smit, B. and Pilifosova, O. (2003). From Adaptation to Adaptive Capacity and Vulnerability Reduction. In S. J. B., K. R. T., and H. Saleemul (Eds.), *Climate Change, Adaptive Capacity and Development*, (pp.9-12). London: Imperial College Press.
- Smit, B. and Pilifosova, O. (2007). Adaptation to Climate Change in the Context of Sustainable Development and Equity. In I. Burton, B. Challenger, S. Huq, R. Klein, G. Yohe, N. Adger, et al., *Fourth Assessment Report* (pp. 879-906).
- Sonne, L. (2010). Bridging the financing gap for pro-poor innovation: Towards a framework.
- Spielman, D. J., Ekboir, J., Davis, K., and Ochieng, C. M. (2008). An innovation systems perspective on strengthening agricultural education and training in sub-Saharan Africa. *Agricultural systems*, 98(1), 1-9.
- Stathers, T., Lamboll, R. and Mvumi, B. M. (2013). Post Harvest Agriculture in a Changing Climate. *Rural 21*. Retrieved July 4, 2014 from, [http://www.rural21.com/uploads/media/rural2013\\_01-S12-14.pdf](http://www.rural21.com/uploads/media/rural2013_01-S12-14.pdf)
- Stanturf, J., Warren, M., Charnley, S., Polasky, S., Goodrick, S. and Armah, F.N.Y. (2011). *Ghana Climate Change Vulnerability and Adaption Assessment*. Washington: US Agency for International Development.

- Taskforce on Climate Change, Vulnerable Communities and Adaptation. (2003). *Livelihoods and Climate Change*. Winnipeg, Manitoba, Canada: The International Institute for Sustainable Development.
- The World Bank. (2013). *Home.Topics. Social Development. RICC:Background*. Retrieved March 24, 2014, from The World Bank: <http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTSOCIALDEVELOPMENT/0,,contentMDK:21555969~isCURL:Y~pagePK:210058~piPK:210062~theSitePK:244363,00.html>
- Thornton P.K, J. P. (2006). *Mapping Climate Vulnerability and Poverty in Africa*. Report to the Department for International Development.
- Tiwari,P. C. and Joshi, B. (2014). Local and regional institutions and environmental governance in Hindu Kush Himalaya Environ. *Science Policy* (2014). Retrieved from HYPERLINK "http://dx.doi.org/10.1016/j.envsci.2014.09.008" \t "doilink" <http://dx.doi.org/10.1016/j.envsci.2014.09.008>
- Tompkins, E. L., Adger, W. N., Boyd, E., Nicholson-Cole, S., Weatherhead, K. and Arnell, N. (2010). Observed adaptation to climate change: UK evidence of transition to a well-adapting society. *Global environmental change*, 20(4), 627-635. Retrieved August 17, 2014, from [http://ac.elscdn.com/S0301479707002897/1-s2.0-S0301479707002897main.pdf?\\_tid=ac51a278-9732-11e4-b077-00000aacb360&acdnat=1420720642\\_c2c6eb057e27260502b5b4de8f7b2ad9](http://ac.elscdn.com/S0301479707002897/1-s2.0-S0301479707002897main.pdf?_tid=ac51a278-9732-11e4-b077-00000aacb360&acdnat=1420720642_c2c6eb057e27260502b5b4de8f7b2ad9)
- Tubiello, F. (2012). *Climate Change Adaptation and Mitigation. Challenges and Mitigation in the Food Sector*. Rome: Natural Resources Management and Environment Department, FAO.
- UNISDR (2009). *UNISDR Terminology on Disaster Risk Reduction*. United Nations International Strategy for Disaster Reduction (UNISDR), Geneva, Switzerland.
- United Nations Framework on Climate Change (UNFCCC). (2007a). *Impacts, Vulnerabilities and Adaptation in Developing Countries*. Bonn, Germany: Produced by the Information Services Department, UNFCCC.
- United Nations Framework Convention on Climate Change (UNFCCC). (2007b). *Home: Full Text of the Convention*. Retrieved March 20, 2014, from United Nations Framework Convention on Climate Change: [unfccc.int/essential\\_background/convention/background/.../2536.ph](http://unfccc.int/essential_background/convention/background/.../2536.ph)
- United Nations Framework Convention on Climate Change (UNFCCC). (2014). *Momentum for Change*. Retrieved February 14, 2014, from UNFCCC: [www.unfccc.int/secretariat/momentum\\_for\\_change/items/7851.php](http://www.unfccc.int/secretariat/momentum_for_change/items/7851.php)
- Uphoff, N. (n.d). *Local Institutions and Participation for Sustainable Development*. International Institute for Environment and Development.

- Uphoff, N. and Buck, L. (2006). Strengthening Rural Local Institutional Capacities for Sustainable Livelihoods and Equitable Development. Paper prepared for the Social Development Department of the World Bank, Washington, DC, Cornell, Cornell International Institute for Food, Agriculture and Development
- Upton, C. (2005). Institutions in a pastoral society: Processes of formation and transformation in post socialist Mongolia. *Comparative Studies of South Asia, Africa and the Middle East*, 25(3), 584-599. Retrieved July 16, 2014, from [http://muse.jhu.edu/journals/comparative\\_studies\\_of\\_south\\_asia\\_africa\\_and\\_the\\_middle\\_east/v025/25.3upton.html](http://muse.jhu.edu/journals/comparative_studies_of_south_asia_africa_and_the_middle_east/v025/25.3upton.html)
- Wehbe, M., Eakin, H., Seiler, R., Vinocur, M., Avila, C. and Marutto, C. (2008). Local perspective on adaptation to climate change: lessons from Mexico and Argentina. *Climate Change and Adaptation*, 1, 315.
- Wolfenson, K. D. M. and Rome, A. (2013). Coping with the food and agriculture challenge: smallholders' agenda.
- World Bank. (2013). *Adaptation Notes*. Retrieved May 27, 2014, from World Bank: <http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/ENVIRONMENT/EXTTOOLKIT3/0,,contentMDK:22285979~menuPK:6409827~pagePK:64168445~piPK:64168309~theSitePK:3646251,00.html>
- Yaro, J. A., Teye, J. and Bawakyillenuo, S. (2014). Local institutions and adaptive capacity to climate change/variability in the northern savannah of Ghana. *Climate and Development*, (ahead-of-print), 1-11. Retrieved December 10, 2014, from <http://www.tandfonline.com/doi/full/10.1080/13549839.2014.965671#tabModule>
- Yengoh, G. T., Armah, F.A, Onumah, E. E. and Odoi, J. O. (2010). Trends in Agriculturally Relevant Rainfall Characteristics for Small-Scale Agriculture in Northern Ghana. *Journal of Agricultural Science*, 2 (3), 3-16. CCSE, Canada.
- Zhao, Y., Wang, C., Wang, S., and Tibig, L. V. (2005). Impacts of present and future climate variability on agriculture and forestry in the humid and sub-humid tropics. In *Increasing Climate Variability and Change* (pp. 73-116). Springer Netherlands. Retrieved on September 14, 2014, from [http://link.springer.com/chapter/10.1007/1-4020-4166-7\\_5](http://link.springer.com/chapter/10.1007/1-4020-4166-7_5)
- Ziervogel, G. and Ericksen, P.J. (2010). Adapting to climate change to sustain food security. *Wiley Interdisciplinary Reviews: Climate Change*, 1(4), 525-540. Retrieved November 4, 2014 from, [http://www.academia.edu/download/30569436/Ziervogel\\_Ericksen\\_WILEY\\_2010.pdf](http://www.academia.edu/download/30569436/Ziervogel_Ericksen_WILEY_2010.pdf)

## APPENDICES

## APPENDIX 1

**UNIVERSITY OF GHANA**  
**CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT**

**Farmer Questionnaire**

*This work is being conducted as part of my MPhil thesis. Please you are assured of strict confidentiality and any information given would be used for academic purposes only. Please feel free to give information to aid this study.*

*Thank you.*

*Serial No .....*

*Location/ Community .....*

**a. Occupational information**

1. What crops do you grow? *Please tick as many as applies to you*

- a. Millet [ ]      b. Maize [ ]      c. Soya Beans [ ]      d. Groundnuts [ ]      e. Yam [ ]  
 f. Cowpea [ ]      g. Vegetables [ ]      h. Cassava [ ]      i. Yam [ ]      j. Cotton [ ]

*Others please specify .....*

2. Can you please state the size of your farm .....
3. For what purposes do you farm?
  - a. As a major occupation [ ] b. For income [ ] c. To provide the family with food [ ]
  - d. As a hobby [ ] **Others please specify**.....
4. Please tick as much as is applicable to you the major tools and implements you use in undertaking your activities?
  - a. Hoe [ ] b. Cutlass [ ] c. Plough [ ] d. Water Cans [ ] e. Water hose [ ]
  - Others please specify**.....
5. Do you keep animals? a. Yes [ ] b. NO [ ]
6. What animals do you rear? a. Goats [ ] b. Sheep [ ] c. Cattle [ ]
  - d. Chicken [ ] e. Guinea fowl [ ] f. Pigs [ ]
  - Others please specify** .....
7. Do your family members help you in your farming activities?
  - a. Yes [ ] b. NO [ ]
8. Do you use hired labour on your farm? a. Yes [ ] b. NO [ ]
9. If yes, how often? .....
- b. Knowledge and perception of environmental change**
10. Have you observed any changes in the environment in this district in recent years?
  - a. Yes [ ] b. NO [ ]
11. If yes, please describe some of the changes you have observed.
  - a. Increasing temperatures [ ] b. Rains coming when they are not expected [ ]
  - c. Increased incidence of storms [ ] d. Loss of vegetation cover [ ]
  - e. Loss of soil fertility [ ]

*Others please specify* .....

12. How long ago did you observe these changes?

- a. For about 5 years [ ]
- b. Between 6-10 years [ ]
- c. Between 10-15 years [ ]
- d. 15- 20 years [ ]
- e. more than 20 years [ ]

13. What do you think is causing these changes?

.....  
.....

14. Tick as many as are applicable the changes that have affected your farming activities?

- a. Low yields [ ]
- b. Plant pests and diseases [ ]
- c. Animal diseases [ ]
- d. Animal mortality [ ]
- e. Loss of crops as a result of intense sunshine or high rainfall

*Others please specify* .....

15. Have you taken any steps to adjust to the changes? a. Yes [ ] b. NO [ ]

16. If yes, can you describe some of the measures you have put in place to cope with the situation?.....

.....  
.....

17. Are they effective? a. Yes [ ] b. NO [ ]

18. Please explain .....

.....  
.....

19. What are others in the community doing to address the changes in the environment?

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

**c. Institutional support in adaptation**

20. Do you receive any form of support from any institution to help you adapt to climate change? a. Yes [ ] b. NO [ ]

*If no, please jump to question 29*

21. If yes, please explain the support

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

22. Can you mention the names of institutions that offer you support?

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

23. Can you please state some of the challenges you faced in your line of production before the introduction of intervention?

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

24. Since you were introduced to the interventions, have you witnessed any improvement in production? a. Yes [ ] b. NO [ ]

25. Can you please mention them?

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

26. Please tick as many as is applicable how this improvement affected your personal life.

- a. Increased income [ ]                      b. Better dietary patterns [ ]
- c. Improved community and family relations [ ]

***Others please specify*** .....

27. How would you rate your production after you implemented the adaptation measures on-farm on a scale of 1-5

- a. High [1]                      b. Moderate [2]                      c. Fairly Moderate [3]
- d. Low [4]                      e. No Change [5]

28. What other things would you want the institution to introduce to improve upon adaptation?

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

***Please move to question 34***

29. Why do you think you have not received any institutional support? Because .....

- a. I am not a member of a co-operative group [ ]      b. I am located in a remote part of the district [ ]
- c. No institution has approached me to offer [ ]
- d. I have no idea [ ]

30. Have you done anything to receive institution support?      Yes [ ]      NO [ ]

31. What do you have to do to receive institutional support?  
 a. To join a co-operative group [ ]    b. To approach an institution [ ]    c. I have no idea [ ]

*Others please specify* .....

32. What are some of the support you would need from institutions to ensure your successful adaptation?

- a. Provision of inputs [ ]                      b. Receiving training in good soil management [ ]  
 c. Receiving monetary support [ ]              d. Receiving extension support [ ]  
 e. Receiving training in animal husbandry [ ]

*Others please specify* .....

33. How do you think provision with these things will improve your productivity or lifestyle?

- a. Increased income [ ]                      b. Better dietary patterns [ ]  
 c. Improved community and family relations [ ]

*Others please specify* .....

34. Are there any selection criteria for farmers to satisfy before they are given support by any institution?              a. Yes [ ]              b. NO [ ]

35. If yes, please explain the selection criteria .....

.....

.....

36. Do you know of a co-operative group operating in this area?

- a. Yes [ ]              b.NO [ ]

37. Do you belong to a co-operative?              a. Yes [ ]              b. NO [ ]

**d. Challenges in accessing institutional support**

38. How easy is it for you to approach institutions for adaptation support?

- a. Very easy [ ]      b. Easy [ ]      c. Indifferent [ ]
- b. Difficult [ ]      e. Very difficult [ ]

39. Have you personally approached an institution for support in climate change adaptation?      a. Yes [ ]      b. NO [ ]

40. If yes, can you tell me your experiences? .....

.....

.....

41. If no, tell me the experience of those you know who tried.

.....

.....

42. Can a farmer group approach an institution for aid in adaptation to climate change?

a. Yes [ ]      b. NO [ ]

43. If no, please explain why

.....

.....

44. Has there ever been any situation where institutions come into the community to meet with farmers to give them support on adaptation?      a. Yes [ ]      b. NO [ ]

45. If yes how many times did they come? .....

46. What kinds of support do they give you?

.....

.....

**e. Strengthening linkages between institutions and smallholder farmers**

47. Please suggest 2 ways institutional support to smallholder farmers can be improved.

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

**f. Demographic Information**

48. Gender

- a. Male [ ]      b. Female [ ]

49. Age

- a. 18- 39 [ ]      b. 40-59 [ ]      c. 60+ [ ]

50. Educational Level

- a. Primary [ ]      b. JHS [ ]      c. SHS [ ]      d. Tertiary [ ]

**Origin**

- a. Indigenous Farmer [ ]      b. Migrant Farmer [ ]

51. Please tell me the size of your household .....

52. Do you live together with your extended family?      a. Yes [ ]      b. NO [ ]

**APPENDIX 2****UNIVERSITY OF GHANA  
CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT****Institutional Interview Guide**

*This work is being conducted as part of my MPhil thesis. Please you are assured of strict confidentiality and any information given would be used for academic purposes only. Please feel free to give information to aid this study.*

*Thank you.*

**a. Institutional Information**

1. Name of institution
2. How long has this organization being in operation in this district?
3. Can you mention the main areas of operation in your institution?
4. How far do your services extend within the district and why?
5. Do you undertake climate change adaptation projects as part of your areas of focus?
6. Do you work directly with smallholders?
7. What work do you do with them?
8. Please mention the various interventions you have introduced to farmers?

9. Do the farmers readily avail themselves to your support?
10. If no, what is preventing them from coming forward?
11. Does your institution receive any form of funding for its climate adaptation projects?
12. Can you please mention the sources of funding?

**b. Conditions underling the levels of institutional access**

13. How do you meet with the farmers?
14. How often do you meet with them?
15. Can a farmer approach your institution for necessary support in climate change adaptation?
16. Can a farmer group approach you for climate change adaptation support?
17. If yes, how is this done?
18. Can you explain the selection criteria upon which your institution stands to select farmers in need of adaptation support?

**c. Challenges of institutions in providing adaptation support**

19. Please mention three things that the farmers do that make it difficult for you to offer them adaptation support.
20. Please explain three obstacles from your institution that affect your efforts at providing adaptation support to farmers.

**d. Enhancing institution- beneficiary relations**

21. Mention three ways by which your institution can be made more accessible
22. Do you collaborate with other institutions working on climate change adaptation projects in the district?

23. If you do, can you please mention the institutions and explain why you collaborate with them?
24. In what ways do you collaborate?
25. If no, why?
26. Does your institution come into conflict with other institutions in the line of providing adaptation support?
27. If yes, can you explain how?
28. Give three ways relations between institutions offering adaptation support can be improved.
29. State two things that can be done to improve smallholder access.

APPENDIX 3

MAP OF THE STUDY DISTRICTS

