

GENDER DIMENSIONS OF ADAPTATION TO CLIMATE CHANGE AMONG  
SMALLHOLDER FARMERS IN RURAL GHANA: A CASE OF NORTHERN GHANA

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## ABSTRACT

### GENDER DIMENSIONS OF ADAPTATION TO CLIMATE CHANGE AMONG SMALLHOLDER FARMERS IN RURAL GHANA: A CASE OF NORTHERN GHANA

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In Ghana, rural households in the semi-arid region are considered the most vulnerable to the negative effects of climate change. Using a mixed-methods approach – key informant interviews, household surveys, and focus group discussions – this study explored climate change perceptions and coping and adaptation practices among male and female heads of farm households in the Lawra district of Ghana. The study further assessed the views of male and female heads of farm households on the effectiveness of current climate change adaptation practices in mitigating climate change impacts and their preferred institutional support for adapting to future changes in climate. Descriptive statistics were used to analyze the quantitative data; the qualitative data was analyzed after coding. Both male and female heads of farm household were aware of long-term changes in rainfall and average temperature and its impacts on their livelihood and household well-being. Heads of farm households engaged in borrowing from village savings and loans groups, selling livestock, migrating to other areas for work, selling fuelwood, and processing shea butter to cope with adverse climate change impacts. Important barriers to adaptation were lack of money, old age or poor health, lack of or inadequate access to labor, and inadequate access to extension services. The results suggest that increased access to credit or income-generating activities, improved access to extension services, and provision of irrigation facilities are important interventions for building the resilience of farm households to a changing climate.

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## CHAPTER ONE

### 1 INTRODUCTION

Agriculture remains a major contributor to Ghana's economy and a source of employment for many rural dwellers. The sector employs nearly 50% of the adult population and is primarily rain-fed, smallholder, and characterized by the use of traditional tools such as hoes and cutlasses in the production process (Food and Agriculture Organization [FAO], 2015). Changes in rainfall and temperature could have a significant impact on agriculture and food security in the country (CC-DARE, 2016). With the high rate of poverty in rural areas of the country, particularly northern Ghana (Adjasi & Osei, 2007), climate change effects on agriculture could worsen the poverty situation and erode gains made toward sustainable development in the country (IPCC, 2007). Further, women farmers, who make up the majority of food crop producers, could be among the worst affected by this phenomenon, with implications for household food security and well-being (Ahmed, et al., 2016; Nelson, 2010). Gendered vulnerabilities may be due to men and women's unequal access and entitlement to productive resources (FAO, 2012).

This discussion has engendered a focus on gender and climate change vulnerability assessment in recent times, but with little attention given to understanding the different adaptive strategies that men and women implement in improving their livelihoods in a changing climate (Chauhan & Vinaya Kumar, 2016). Previous studies have shown that climate change knowledge, adaptation implementation, and constraints to farmers' ability to adapt to climate impacts are closely related to the gender of the farmer (Diirro et al., 2016; Jin, Wang, & Gao, 2015; Lambrou & Nelson, 2010). This study aimed to contribute to the discourse on gender and climate change adaptation by assessing the climate change perceptions of male and female heads of farm households in northern Ghana and the coping and adaptation practices they adopt to mitigate climate change impacts.

The thesis is organized into four chapters. The first chapter presents a general introduction to the thesis and the definition of terms guiding the study. Chapters two and three have been developed as independent papers. The second chapter explores the gender dimensions of climate change perceptions and current adaptation practices for reducing adverse climate change impacts. It also identifies constraints to climate change adaptation among male and female heads of farm households. The third chapter explores coping and adaptation measures of male and female heads of farm households and examines their perspectives on the effectiveness of current adaptation practices. In addition, it assesses the preferences of male and female heads of household for potential institutional supports for adapting to future changes in climate and the preferred sources for these potential adaptation supports. By exploring these issues, the study aims to add to the literature on gender and climate change adaptation among smallholder farmers and broaden our understanding about the constraints that male and female farmers face in trying to adapt their livelihood activities to a changing climate. The fourth chapter presents summary of the findings, conclusions and recommendations.

## 2 DEFINITION OF TERMS

For the purposes of the study, the researcher defines the following within the study context.

Smallholder farming: “farming and associated activities which together form a livelihood strategy where the main output is consumed directly, where there are few if any purchased inputs and where only a minor proportion of output is marketed”(Barnett, Blas, & Whiteside, 1996, p.1) and operating land size is fewer than 25 acres.

Livelihood: assets (comprising a range of material and social resources), abilities, and activities necessary for a means of living (Scoones, 1998).

Livelihood strategies: the combination of income generation and subsistence activities practiced by farm households (with crop and livestock being predominant) to secure the well-being of members within the household. Such activities could be undertaken within the community or outside the community (Ellis, 2006). Crop and livestock production activities of the household are the main livelihood activities for this study.

Household: a group of people who live together in a common living space, eat from the same kitchen, and accept the authority of a co-resident male or female as the head of the household.

Male head of household: an adult male who is single or married, lives in the same house with one or more wives, or is a widower and is the main decision maker in relation to household farming activities.

Female head of household: an adult female who is single or married/cohabiting whose husband/partner is mostly absent for most of the calendar year or is widowed and could be the main decision maker about household farming activities and well-being.

Adaptation measures/strategies: any farming-related activity undertaken by male-headed and female-headed farming households for the purposes of reducing the negative consequences of actual or expected climatic stimuli on their farming activity and the well-being of others in their household.

Vulnerability: “the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes” (IPCC, 2007, p. 6).

Climate change: Following the definition of Bryan et al. (2013), climate change in this study is defined as perceived changes in rainfall and temperature during the growing season from 2006 to 2016.

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## CHAPTER TWO

### EXPLORING CLIMATE CHANGE PERCEPTIONS AND CHALLENGES TO ADAPTATION AMONG SMALLHOLDER FARMERS: A GENDER ANALYSIS

#### ABSTRACT

Gender-sensitive climate change adaptation strategies can improve gender equality and women's development in agrarian communities. This study used both qualitative and quantitative research methods (focus group discussions, key informant interviews, and household surveys) to explore the perspectives of male and female heads of farm household on climate change, including climate change impacts on their farming activities and household well-being, and challenges faced in mitigating climate change impacts. Results showed similarities in climate change perceptions between male and female heads of farm households. Empirical data showed rising temperatures, a shortened cropping season, and increasingly erratic rainfall as the main climatic stressors. Lack of money and inadequate access to labor among the female heads and inadequate access to extension and old age/poor health among the male heads were observed as the major constraints to mitigating climate change impacts. Integrating gender needs in climate change adaptation planning and intervention development can help build resilient farm households.

Key words: climate change; gender inequality; agriculture; food security

## 1 INTRODUCTION

The negative impacts of climate change pose a significant threat to household food security and could erode the gains made toward eradication of poverty in sub-Saharan Africa, where many people depend on agriculture, a climate-sensitive activity, for their livelihoods and well-being (Perez et al., 2015; Rosenthal & Kurukulasuriya, 2003). In Ghana, the agricultural sector employs about 50% of the adult rural population. Agriculture is primarily rain-fed, smallholder, and characterized by use of traditional tools such as hoes and cutlasses in the production process (FAO, 2015). The threat of climate change impacts on the agricultural sector requires the development and implementation of interventions with the active participation of stakeholders to adapt agriculture to the changing climate and to ensure sustained improvement in the well-being of farm households (Diirro et al., 2016). The formulation of such interventions may include gender dimensions of climate change perceptions of farm households, climate change impacts, and challenges faced by farm households in reducing their vulnerability to the impacts of climate change (Denton, 2002; Jin et al., 2015). Such interventions will help farm households to take advantage of the opportunities presented by climate change and also help to adequately mitigate the harm posed by climate change. For example, farm households could take advantage of the changing climate to cultivate new crops that respond well to the climate.

Assessing gender dimensions of climate change can highlight the differences in knowledge of males and females about the occurrence of climate change and its impacts. Additionally, an assessment of gender dimensions of climate change can offer opportunities to determine the challenges faced by male and female farmers in dealing with the impact of climate change on their livelihoods. A study conducted by Kisauzi, Mangheni, Sseguya, and Bashaasha (2012) found that men and women farmers in Uganda differed in their perceptions of causes of climate change. They

observed that females had weaker understanding about causes of climate change and attributed the findings to low education level and lack of access to resources and information on climate change. Thus, an assessment of gender dimensions of climate change can highlight the factors that drive differing views on climate change among smallholder farmers.

Gender-equitable sustainable development is an important avenue through which smallholder farmers in developing countries can effectively adapt to the projected impacts of climate change (Terry, 2009). The development of gender-sensitive adaptation measures is important because females in most developing countries are increasingly becoming heads of farm households. Several researchers have suggested that climate change vulnerabilities are not likely to be gender-neutral (Ahmed, et al., 2016; Diiro et al., 2016; Jin, Wang, & Gao, 2015; Goh, 2012). In Ghana, females make up about half of the agricultural labor force, with their production activities mainly geared toward ensuring household food security (Nelson, 2010). These females have lower adaptive capacity to climatic stressors than males because of their limited access to productive resources and restrictions to participation in decision-making processes at both household and community levels (FAO, 2012). The situation could be worsened by the changing climate and lead to undesirable consequences in the country (Jin, Wang, & Gao, 2015; Vincent, et al., 2011). Given females' contribution to household food security, it is crucial to include gender perspectives in adaptation planning (Vincent et al., 2011).

The government of Ghana recognized the need for gender mainstreaming in planning and developing climate change adaptation policies to improve the resilience of farm households (CC-DARE, 2016). The success of such intervention depends on in-depth understanding of the differences in climate change perspectives among male and female farmers and their choice of adaptation measures (Jin et al., 2015). Climate change research that has explored the linkages

between gender and climate change adaptation in Ghana has mostly focused on community-level analysis (Ahmed et al., 2016; Codjoe, Atidoh, & Burkett, 2012; Jost et al., 2015; Nyantakyi-Frimpong & Bezner-Kerr, 2015). For example, Ahmed et al. (2016) used key informant interviews and focus group discussions to explore gender differentiation in climate change adaptation among farmers in two districts in northern Ghana. The study findings revealed gendered vulnerability and adaptation to climate change. Jost et al. (2015) explored gender dimensions of climate change adaptation among smallholder farmers in terms of mobility and access to information. They found that access to timely weather information and seasonal forecasts was crucial for planning crop cultivation and household duties among male and female farmers.

Relying primarily on empirical data from the Lawra district in northern Ghana, this study explores the perspectives of male and female heads of household on climate change, determines the impact of climate change on livelihoods and household well-being, and assesses the factors that can impede adaptation to climate change. Thus, the study aims to answer the following research questions:

1. How do male and female heads of farm households perceive climate change, its causes, and its effects on their livelihoods and household well-being?
2. How concerned are male and female heads of farm households about the effects of climatic stressors on their livelihood activities?
3. What challenges hinder effective adaptation to climate change among male and female heads of farm households?

The study aims to broaden understanding of the gender dimensions of climate change among farmers. In addition, it draws the attention of policymakers to developing climate change adaptation measures tailored to the needs of male and female smallholder farmers.

## 2 GENDER, CLIMATE CHANGE, AND SMALLHOLDER AGRICULTURE

The importance of gender in agriculture is underpinned by the different roles played by males and females. In many African communities, females in rural areas combine household duties such as cooking, cleaning, washing, child care, and gathering of firewood with working on the farm and/or taking care of livestock. Because of increasing poverty (partly due to climate change) in the rural farming communities, male farmers typically migrate to search for wage jobs as a coping mechanism. This tends to increase women's agricultural workload. The lack of capacity and unequal access to productive resources due to existing sociocultural norms and gender roles could inhibit the ability of females to undertake adaptation practices and make them vulnerable to climate variations (Jost et al., 2015). It is estimated that females make up to about 44% of the global agricultural labor force; similarly, an estimated 50% of females are engaged in agricultural production in sub-Saharan Africa (Doss et al., 2011). Female productive activities largely involve the production of crops for household consumption; those of the males typically involve the production of crops for sale (Jost et al., 2015). Livingston, Schonberger, and Delaney (2011) report increasing migration of males from rural communities in search of better economic opportunities and a rising number of female heads of household in sub-Saharan Africa. In Ghana, for example, the Food and Agriculture Organization (2012) estimates that 20% of females are heads of farm households in rural communities. Thus, it is important to include gender perspectives on climate change in agricultural adaptation planning.

Jost et al. (2015) reported that farmers in Ghana view climate change as changing rainfall patterns and declining soil fertility. In their work, the farmers attributed climate change to increased deforestation. Further, they found that male and female farmers differed in their choice of climate change adaptation practices. Particularly, female farmers were reluctant to engage in adaptation

practices that produced results in the long term because they did not own the farmlands. Babugura, Mtshali, and Mtshali (2010) examined the effects of climate change on male and female farmers and reported an increased incidence of extreme climatic events such as strong winds, wildfires, cold winters, dry climate, and droughts. They observed that male and female farmers were forced to look for alternative sources of income because of declining agricultural yield and income, which were attributed to climate change

Jin et al. (2015) assessed the gender dimensions of climate change perspectives and adaptation practices at the household level and found that male heads of farm households in China were more likely to adopt agricultural water conservation practices, while female heads of farm households preferred planting drought-tolerant crops. Diiro et al. (2016) found that both male and female heads of farm households in Mali observed changes in climate and implemented a variety of strategies to mitigate the impacts. Their study showed that a lower proportion of female heads of farm households than male heads implemented adaptation practices. They further indicated that female heads of farm households were constrained by lack of money and access to labor and land.

Highlighting the gendered vulnerability of climate change impacts in agriculture, Tibesigwa et al. (2015) found that female-headed households in South Africa were vulnerable to climate change-induced food insecurity largely because they were mainly dependent on climate-sensitive activities for their livelihoods. Similarly, Diiro et al. (2016) found that female-headed households were more vulnerable to climate change impacts. However, Babugura, Mtshali, and Mtshali (2010) found that male heads of farm households in South Africa were rather more vulnerable to the impacts of climate change than female heads of farm households. Antwi-Agyei et al. (2013) assessed household vulnerability in three communities in Ghana and found that female-headed households, particularly those with unreliable and less diversified sources of income, were more vulnerable to

the impacts of climate change than male-headed households. Additionally, Codjoe, Atidoh, and Burkett (2012) found that female smallholder farmers were more vulnerable to climatic events than male smallholder farmers. Even though these studies addressed different aspects of climate change issues in agriculture, all the studies underline the significance of exploring the gender dimensions of climate change impacts and adaption strategies.

### 3 CONCEPTUAL FRAMEWORK

Gender is defined as “the socially constructed roles, responsibilities and opportunities associated with males and females, as well as hidden power structures that govern the relationships between them” (Vincent et al., 2011, p.5). Gender constructions in most societies tend to influence male and female access to critical resources necessary for their development. This affects the differential abilities of males and females to counter the negative impacts of climate change. Further, gender constructions highlight traditional roles and differences that undermine gender equality (Vincent et al., 2011). In this paper, gender represents differences in productive resources of male and female heads of farm households. Male heads of farm households comprise of adult males who are single, are cohabiting or married (and live in the same house with one or more wives), or are widowed, and serve as the main decision maker in the farm household. Similarly, female heads of farm household include adult females who are single or married/cohabiting (with husbands/partners absent for most of the calendar year), or are widowed, and could be the main decision makers of the farm households (Tibesigwa et al., 2015). According to Vincent et al. (2011), male and female heads of farm households have dissimilar positions, roles, perceptions, needs, and control over and use of resources. This situation influences the extent to which their farming activities and households are affected by climatic events. Hence, it is crucial to understand the gender dimensions of current coping and adaptation measures adopted by farm households to

mitigate climate change impacts and adaptation constraints to improve adaptation planning and development processes (Ahmed et al., 2016; Diiro et al., 2016).

Denton (2002) stressed the importance of gender mainstreaming in climate change mitigation and adaptation in sustainable development. Specifically, Denton argued that the perspectives of females on agricultural production and environmental management are crucial in achieving sustainable development under the threats of climate change. However, very little effort has been made to understand these perspectives and make them a fundamental part of mainstream adaptation policy planning and development. Diiro et al. (2016) also argued for the inclusion of male and female perspectives in adaptation planning for the effective development of adaptation and mitigation strategies. Therefore, it is necessary to explore the perspectives of male and female farmers to help in the planning of climate change adaptation for sustainable development.

## 4 METHODS

### 4.1 Study Area

The study was conducted in three communities (Metttoh, Kasalgri, and Tabier) in the Lawra district of the Upper West Region of Ghana. The district lies between latitude 10°35' to 10°40' N and longitude 2°50' to 2°53' W. The Ghana Statistical Service (2014) estimated that 80% of the population in the district lives in rural areas. The district lies within the semi-arid region and experiences a unimodal rainfall season with annual rainfall ranging from 800 to 1200 mm and an annual mean temperature ranging from 27 to 36°C (Ahmed et al, 2016; Ndamani & Watanabe, 2015). Farming in the district is rain-fed, and mainly begins in May and ends in October. The topography of the area is mostly flat to undulating. Soils are characterized by low organic matter content, low mineral fertility, and poor water holding capacities (Ghana Statistical Service, 2014).

About 93% of the population in the Lawra district is engaged in agriculture, cultivating crops such as maize, millets, groundnuts, soya bean, and black-eyed pea (Ghana Statistical Service, 2014). Male farmers in the district practice greater crop diversity than females (FAO, 2012). There are no gender-specific crops, although females are more likely to cultivate groundnut (peanut) and some other crops than males. Farmers in the district supplement their crop production activities with livestock rearing, with goats as the dominant livestock (FAO, 2012). The district has a high poverty level and is considered the most vulnerable to climate change impacts (Ahmed et al., 2016).

#### 4.2 Data Collection

The data collection took place in three stages: key informant interviews, household surveys, and focus group discussions. In the first stage, key informant interviews were used to collect data from male and female community leaders and government agricultural officials in the farming communities within the Lawra district. The services of a translator were employed whenever the interviewee could not communicate in the English language. Data were collected in June 2017. With the help of a contact person, purposive sampling was used to select local community leaders and government agricultural workers for the key informant interviews. Purposive sampling is used when you want to source information from persons who are well informed about the subject of inquiry (Babbie, 2010). A total of nine key informant interviews were conducted to explore farmers' perceptions of rainfall and temperature variations over the previous decade (2006-2016) to capture the perceived impacts of climatic changes on farmers' activities and to determine the challenges faced by the farmers in adapting to climate change impacts. All interviews were audio recorded with the permission of informants.

In stage 2, a household survey instrument was designed following recommended practices (Dillman, Smyth, & Christian, 2014). The draft survey instrument was revised on the basis of

recommendations from a panel of researchers at Michigan State University in the United States. The survey instrument was designed to measure sociodemographic characteristics, assess climate change perceptions, identify participants' perception about the causes of climate change and its impacts on livelihood activities and household well-being, and to determine the challenges in reducing vulnerability to climate change impacts. Four survey items were used to measure participants' perception and awareness of the changes in rainfall and temperature and related climatic events in the previous decade; causes of the changes in the climate; household sources of weather information; and the effects of the perceived climatic changes on their livelihood and household well-being. Perceived changes in rainfall and temperature and related climatic events were measured on a three-point Likert scale: 1 (decreasing climate events), 2 (no changes in climate events), and 3 (increasing occurrence of climate events). A five-point Likert-type question was used to assess perceptions of study participants on the severity of effects of climate change impacts on their crop and livestock production activities and household well-being. An open-ended item was used to determine the perceived barriers hindering the ability of male and female heads of farm households to successfully adapt to the changes in climate.

The household survey participants (male and female heads of farm households) were selected through convenience sampling using the criteria that the participant was from one of the following types of household: male-headed, with one or more wives; male-headed, divorced, single, or widowed; female-headed, divorced, single, or widowed; female-headed, husband or partner away, husband makes most household and farm decisions; and female-headed, husband or partner away, wife makes most household and farm decisions.

The survey instrument was revised and finalized using feedback from enumerators and pretest participants after a two-day training and pretesting program. For example, climate change impacts

on crop and livestock production and household well-being were captured with two separate questions. The survey instrument was administered to study heads of farm households using face-to-face survey methods (Suvedi & Kaplowitz, 2016). A total of 124 household surveys – from 56 male heads of farm households and 68 female heads of farm households – were conducted.

In the final stage of data collection, focus group discussions were conducted following recommended procedures and protocols (Suvedi & Kaplowitz, 2016). A total of five focus group discussions were conducted: two each (men and women separately) in Mettoh and Kasalgri, respectively, and one joint focus group in Tabier. In each community, 12 male and 12 female heads of farm households were invited for the focus group discussions. Each focus group discussion had nine to 15 participants. Participants (male and female heads of farm household) in the focus group discussions were selected on the basis of their availability and willingness to participate in the process, with consideration for their position in the community, the type of household they came from (male-headed or female-headed household), and farming experience. A total of 54 heads of farm household (26 males and 28 females) participated in the focus group discussions. With the consent of the participants, the focus group discussions were audio recorded and later transcribed into English for further processing and analysis.

#### 4.3 Data Analysis

The qualitative data from the interviews and focus group discussions were coded on the basis of themes and concepts identified after reviewing the transcripts. The coding scheme was developed following the identified themes (Miles, Huberman, & Saldanna, 2014). The concepts, tags, definitions, and rules that guide the application of the codes were defined in the coding scheme. During the coding process, similar themes were collapsed into one category, and new codes created

for new themes that emerged (Beotto & Mckinnon, 2013). Further, statements were written to summarize the various themes that were identified in the coding process.

The quantitative data from the household surveys were processed and analyzed using SPSS, version 22. Frequency, percentage, mean, standard deviation, and graphs were used to describe household and farm characteristics, perceptions of changes in rainfall and average temperature and related climatic events, and causes of climate change, among others. The qualitative data from the household surveys were analyzed by grouping the data into categories and entered into Microsoft Excel for further analysis.

## 5 RESULTS

This section presents results from the key informant interviews, the household surveys, and the focus group discussions, and focuses on household and farm characteristics of participants, farmers' perceptions of changes in rainfall and temperature from 2006 to 2016, farmers' concerns about the impacts of climate change on crop and livestock production, and perceived challenges to effective adaptation to climate change impacts. Using codes (KII = key informant interview, FGD = focus group discussion), some of the responses from the participants are reported verbatim for illustration.

### 5.1 Household and Farm Characteristics of Participants

The characteristics of the study participants are presented in Table 2.1. The average age of the study participants was 52 years. About 12% of female heads of farm household had some form of formal education, and 25% of male heads of farm households had formal education. About 59% of the 124 heads of farm household were members of local groups. Each household averages around seven persons and cultivates at least 2 acres (0.8 hectare) of farmland. Male heads of farm households had about three decades of experience in farming; female heads of farm households

had about two decades of farming experience. Though each of the households worked more than one farm at every farming season, the male heads of farm households received three times more in income than female heads of farm households because the male heads of farm household typically operated about five farms, while the female heads of farm households operated about three farms. Additionally, many of the female heads of farm household largely produced to feed their families, while the male heads of farm household mainly sold their produce. Crop and livestock production were the predominant sources of income. These two farming activities contributed at least 70% of household income for both the male heads of farm households (82.1%) and the female heads of farm households (70.1%). Other sources that accounted for more than 12% of household income included the production and sale of shea butter, firewood, and locally brewed beer (called “pito”) by females, and hunting, fishing, and working as a butcher by males.

Table 2.1 Household and Farm Characteristics by Household Type.

| Characteristics                                | MHH (N = 56)<br>Mean (SD) | FHH (N = 68)<br>Mean (SD) | Total (N = 124)<br>Mean (SD) |
|------------------------------------------------|---------------------------|---------------------------|------------------------------|
| Age (years)                                    | 51.71 (15.21)             | 52.38 (15.45)             | 52.08 (15.28)                |
| Formal education (%)                           | 25 (.44)                  | 11.8 (.32)                | 17.7 (.38)                   |
| Group membership (%)                           | 46.4 (0.50)               | 69.1 (.32)                | 58.9 (.49)                   |
| Household size                                 | 7.98 (3.43)               | 6 (2.16)                  | 6.90 (2.97)                  |
| Farming experience (years)                     | 30.73 (15.15)             | 19.75 (13.93)             | 24.71 (15.45)                |
| Farm size (acres)*                             | 5.66 (3.69)               | 2.48 (1.4)                | 3.92 (3.11)                  |
| Number of farms                                | 4.91 (2.29)               | 2.8 (1.4)                 | 3.74 (2.12)                  |
| Household income in the past 12 months (GHS)** | 1045.09<br>(1237.51)      | 375.67<br>(536.14)        | 690.69<br>(988.65)           |
| <b>Main source of income (%)</b>               |                           |                           |                              |
| Crop and livestock production                  | 82.1                      | 70.6                      | 75.8                         |
| Trading                                        | 1.8                       | 7.4                       | 4.8                          |
| Civil or public servant                        | 1.8                       | 0.0                       | .8                           |
| Remittance                                     | 8.9                       | 2.9                       | 5.6                          |
| Other                                          | 5.4                       | 19.1                      | 12.9                         |

\*1 acre = 0.40 ha.

\*\*1USD = GHS 4.12 at the time of survey.

## 5.2 Farmers' Perceptions of Long-Term (2006-2016) Changes in Rainfall, Temperature and Occurrence of Extreme Climatic Events

To measure farmers' awareness of changes in rainfall and average temperature over the past decade, researchers asked the study participants whether they observed any changes in rainfall and temperature over that period. All the study participants noted changes in rainfall and temperature. As shown in Table 2.2, both male and female heads of farm households reported rising temperatures in the study communities and seemed to agree that the weather is becoming increasingly hotter. According to a key informant, the weather is becoming hotter because of lack of rain:

When we were young, we had a lot of rains so there was not much sunlight and heat stress. Nowadays, the heat is too much because there is no rain. (KII 04)

A participant from the male focus group discussions agreed with this and stated:

The temperature has been increasing over the period. When you have the rain then it will be cool, but because it does not rain, the temperature has gone up. (FGD 03)

Male and female heads of farm households agreed that rainfall, which signals the start of the crop growing season, has been occurring later in the year. The qualitative results support this view. Responses from the study participants suggest that farmers were previously certain about the onset of rains in March or April to begin cropping activities. However, over the past decade, the rains usually began in May or June. A male key informant made the following statement to demonstrate this observation:

The rains usually started in March or April, but nowadays it begins in May or June. This year, we started planting our groundnut in May because the rain started in May. It rained for a short time and we have not had rain again. Our groundnuts did

not sprout; June is about ending, we still don't have rain. We are waiting for the rain to replant the groundnuts. I have seen a difference in the rainfall pattern, and it is really affecting our farming. (KII 05)

This suggests that rainfall, which is the major source of water for farming activities within the study area, is becoming unreliable. According to the study participants, the late onset of rainfall, low rainfall amounts, and sudden or intermittent stops in rainfall during critical growing periods make rainfall unreliable for crop production. The duration of the cropping season had generally decreased over the decade and was attributed to the late onset of spring rains. No differences were found in perceptions about rainfall and temperature between the male and female heads of farm households.

Table 2.2 Farmers' Perceptions of Changes in Rainfall, Temperature and Climatic Events.

| Variable                                                       | MHH (N = 56)<br>Mean (SD) | FHH (N = 68)<br>Mean (SD) | Total (N = 124)<br>Mean (SD) |
|----------------------------------------------------------------|---------------------------|---------------------------|------------------------------|
| Change in temperature                                          | 2.50 (.83)                | 2.25 (.90)                | 2.36 (.88)                   |
| Incidence of early onset of rainfall during the growing season | 1.63 (.91)                | 1.35 (.75)                | 1.48 (.83)                   |
| Incidence of late onset of rainfall during the growing season  | 2.46 (.76)                | 2.53 (.78)                | 2.50 (.77)                   |
| Duration of rainfall for the growing season                    | 1.66 (.92)                | 1.49 (.84)                | 1.56 (.88)                   |
| Incidence of flooding during crop growing season               | 1.91 (.81)                | 1.67 (.69)                | 1.77 (.75)                   |
| Incidence of dry spells or droughts                            | 2.54 (.88)                | 2.38 (.96)                | 2.45 (.77)                   |
| Incidence of dry spells or droughts                            | 2.54 (.88)                | 2.38 (.96)                | 2.45 (.77)                   |
| Duration of heat stress                                        | 2.35 (.77)                | 2.27 (.86)                | 2.31 (.82)                   |

Scale: 1=Decreased, 2=Stayed the same, 3=Increased

Further, as shown in Table 2.2, both male and female heads of farm households reported decreasing to unchanged trends in the occurrence of flooding in their communities. An attempt was made to explore the reasons behind flooding events experienced in the communities. The focus group results indicated that flooding events were attributable not only to rainfall but to other activities, including the opening of a dam (Bagre dam) in neighboring Burkina Faso (located north of the Upper West Region of Ghana) and poor channeling of waterways from farms during and after road construction.

According to the study participants, there has been an increased incidence of dry spells and droughts in the past decade. These dry spells and droughts have been lasting between seven and 14 days and, in some cases, for about a month. The study participants attributed high temperatures and increased heat stress to reduction in rainfall events. Increasing windstorms during the cropping season were also reported as major climatic events undermining crop production and household well-being. The farmers reported that windstorms have become strong and frequent, and they (windstorms) sometimes uproot trees and/or remove roofs of houses in the communities.

During the key informant interviews and focus group discussions, participants reported local indicators that to them represented changes. Some of the indicators reported were shortening of the crop growing season; loss of vegetative cover, particularly in relation to the number of economic trees in the communities; drying up of streams or water bodies; reduced soil fertility; reduction in the population of game; reduced populations of migratory birds that signal the beginning of the rainy season; and increased incidence of crop and animal pests and diseases that were previously not common in the communities. Other reported indicators included unexplained death of livestock, the switch from the cultivation of traditional varieties of crops to drought

tolerant and early-maturing varieties, and in some instances, stopping the cultivation of certain crops.

### 5.3 Farmers' Sources of Information on Rainfall and Temperature in the Past Decade

Access to information on rainfall events and temperature during the crop growing season is crucial for farmers because it enables farm households to plan their farming activities: land preparation, selection of crops for cultivation, and application of soil amendments. The main sources of rainfall and temperature information (Table 2.3) as reported by the farmers were agricultural extension agents, friends, neighboring farmers, family members' use of indigenous knowledge, and the media (radio). Among male heads of farm households, the top four sources of information on rainfall and temperature were agricultural extension agents (80%), radio (77%), use of indigenous knowledge (77%), and friends (75%). Neighboring farmers (67%), friends (66%), agricultural extension agents (63%), and use of indigenous knowledge (63%) were the top four sources of information on rainfall and temperature for the female heads of farm households. Female heads of farm households relied on their social networks for weather information. Though male heads of farm households also relied on their social networks for weather information, agricultural extension agents, radio, and indigenous knowledge were the leading sources.

Table 2.3 Sources of Information on Weather from 2006 to 2016.

| Source of information         | MHH (N = 56)<br>Frequency (%) | FHH (N = 68)<br>Frequency (%) | Total N = 124<br>Frequency (%) |
|-------------------------------|-------------------------------|-------------------------------|--------------------------------|
| Agricultural extension agents | 45 (80)                       | 43 (63)                       | 88(71)                         |
| Neighboring farmers           | 40 (71)                       | 44 (67)                       | 84 (70)                        |
| Friends                       | 42 (75)                       | 45 (66)                       | 87 (70)                        |
| Other family members          | 41 (73)                       | 40 (59)                       | 81 (65)                        |
| Indigenous knowledge          | 43 (77)                       | 43 (63)                       | 86 (69)                        |
| Radio                         | 43 (77)                       | 27 (40)                       | 70 (57)                        |
| Others*                       | 4 (7)                         | 7 (10)                        | 11 (9)                         |

\*Mobile phone text messaging

#### 5.4 Farmers' Perception of the Causes of Changes in Rainfall and Temperature

Farmers' perceptions of the causes of climate change in the study communities are summarized in Figure 2.1. The farmers largely attributed changes in rainfall pattern and temperature to bushfires and deforestation. According to some of the farmers, the changing climate was a natural phenomenon or due to God's will and the work of angry deities. There were marginal differences in perceptions of causes of climate change between male and female heads of farm households.

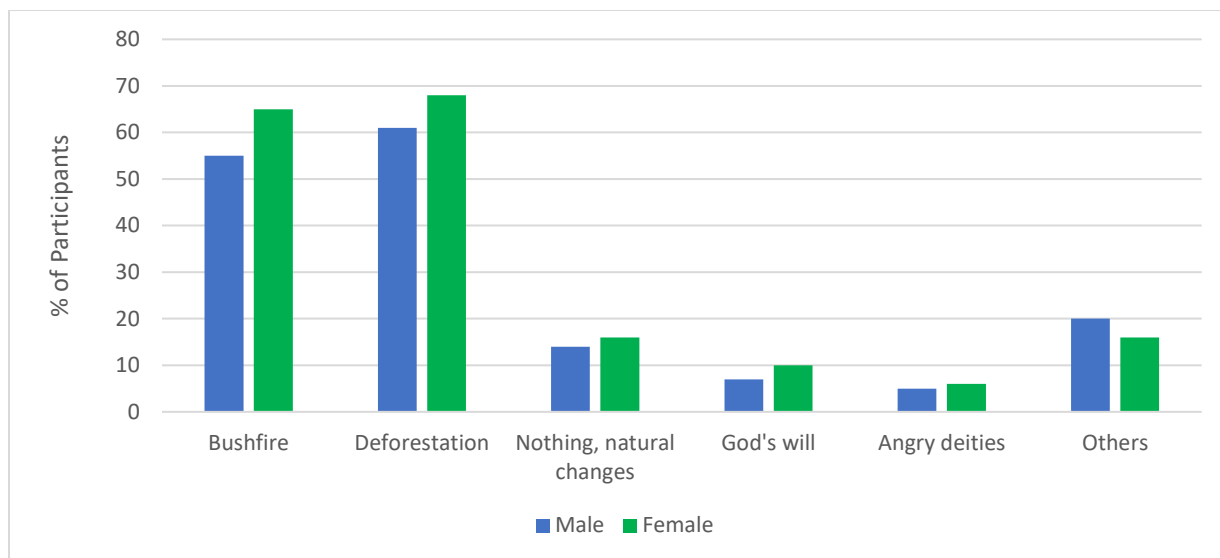


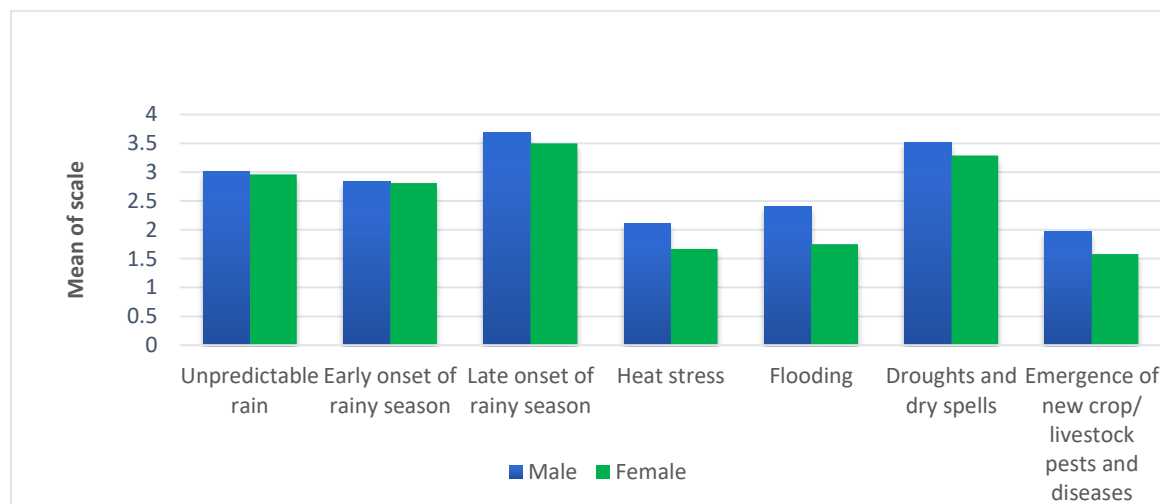
Figure 2.1. Farmers' Perceptions of Causes of Climate Change.

Key informant interviews and focus group discussions indicated that the bushfires were largely due to farmers' traditional practice of burning crop residues to prepare the land for the next cropping season. Additionally, the bushfires were attributed to uncontrolled burning by males when hunting for game. Tree cutting by females for firewood, road construction, and site clearing for development projects accounted for deforestation and loss of vegetative cover. Further, certain traditional beliefs were perceived to influence the climate. For example, the changing climatic events were attributed to depletion of sacred groves and disregard for traditional practices. The

farmers stated that failure to appease the gods when a sacred grove is desecrated displeases the deities, resulting in unreliable rainfall and increasing temperature.

### 5.5 Farmers' Concerns about the Impacts of Climate Change on Livelihood Activities

Generally, there was a moderate to high level of concern for the impacts of climatic stressors on livelihood activities of the farmers (Figure 2.2). The study participants were concerned about unpredictable rain, late onset of the rainy season, and droughts and dry spells. This situation is crucial because more than half of the participants (63%) indicated that they relied solely on rainfall for their farming activities. The remaining relied on both rainfall and irrigation.



Scale: 1=Not concerned at all, 2= Less concerned, 3 = Concerned 4= Very concerned.

Figure 2.2. Farmers' Concerns about Impacts of Climate Change on Livelihood Activities.

Through the focus group discussions, it emerged that the rainy season had become increasingly erratic, with study communities experiencing late onset of the spring rains, longer periods of dry spells, and early cessation of rains during the crop growing season. The study participants showed less concern about heat stress, flooding, and emergence of new crop and livestock diseases. During the focus group discussions, participants indicated that heat stress, droughts and dry spells, and the

emergence of new crop and livestock diseases were due to poor and erratic rains during the cropping season.

They explained that good and regular rains during the crop growing season could result in cooler temperatures and less incidence of crop and livestock diseases. To them, the rainwater would wash away the pests and diseases associated with harsh weather:

The rainfall has been unreliable nowadays and has been affecting our crop yield.

The rains are unpredictable, and there are long periods of dry spells which kill our crops. The temperature is always high nowadays because it does not rain properly.

We have increased incidence of crop and livestock pests and diseases because of the dry weather. If it rains, the rain will wash the pests and diseases away. (FGD 02)

It was observed that the male heads of farm households showed concern about the impacts of changes in rainfall and temperature on crop and livestock production, while the female heads of farm households were concerned about the unavailability of markets and labor and credit constraints.

#### 5.6 Perceived Effects of Climate Change on Farming Activities and Household Well-being

In general, both male and female heads of households indicated that their crop and livestock production and household well-being were affected by the long-term changes in rainfall (Table 2.4). However, male heads of farm household reported greater effects (mean = 3.79, SD = .93) caused by these long-term changes than did their female counterparts. Follow-up questions were asked to better understand the specificity of climate change impacts on households' crop and livestock production. The key effects of the changes were decreased crop yield (94%), less fodder available for livestock (49%), and loss of crops and livestock to pests and diseases (39%).

Table 2.4. Perceived Effects of Climate Change on Farming Activities and Household Well-being.

| Statements                                                                                    | MHH (N = 56)  | FHH (N = 68)  | Total<br>N = 124 |
|-----------------------------------------------------------------------------------------------|---------------|---------------|------------------|
|                                                                                               | Mean (SD)     | Mean (SD)     | Mean (SD)        |
| Crop and livestock production were affected by long-term changes in rainfall and temperature. | 3.79 (.93)    | 3.43 (1.12)   | 3.59 (1.05)      |
| Household well-being was affected by long-term changes in rainfall and temperature.           | 3.55 (.93)    | 3.49 (1.13)   | 3.52 (1.04)      |
| <b>Perceived effects of climate change on crop and livestock production</b>                   |               |               |                  |
|                                                                                               | Frequency (%) | Frequency (%) | Frequency (%)    |
| Decreased crop yields                                                                         | 54 (96)       | 62 (91)       | 116 (94)         |
| Less fodder available for livestock                                                           | 29 (52)       | 29 (43)       | 58 (49)          |
| Loss of backyard gardens or farms                                                             | 13 (23)       | 3 (4)         | 16 (13)          |
| Loss of crop and livestock to pests and diseases                                              | 26 (46)       | 22 (32)       | 48 (39)          |
| Low livestock productivity                                                                    | 11 (20)       | 11 (16)       | 22 (18)          |
| Stopped cultivation of certain crops                                                          | 6 (11)        | 8 (12)        | 14 (11)          |
| Reduced or loss of soil fertility                                                             | 20 (36)       | 10 (15)       | 30 (24)          |
| <b>Perceived effects of climate change on household well-being</b>                            |               |               |                  |
| Scarcity of fuelwood                                                                          | 7 (12)        | 14 (21)       | 21 (17)          |
| Poor household health                                                                         | 28 (50)       | 14 (21)       | 42 (34)          |
| Shortage of water for drinking and household chores                                           | 6 (11)        | 4 (6)         | 10 (8)           |
| Scarcity of food due to reduced yield or total loss of crops                                  | 51 (91)       | 58 (85)       | 109 (88)         |
| Loss of income due to yield losses                                                            | 35 (63)       | 33 (49)       | 68 (55)          |
| Reduction in number of meals eaten in a day                                                   | 33 (59)       | 38 (56)       | 71 (57)          |

The key informant interviews and focus group discussions showed that the households experienced yield losses when there were prolonged periods of dry spells and during shortened crop growing seasons. Household members walked for long hours in search of fodder to feed farm animals. In

some cases, the animals were left to search for fodder on their own. These farm animals were sometimes stolen, resulting in losses.

Loss of crops and livestock to pests and diseases (46%), reduced or loss of soil fertility (36%), loss of backyard gardens or farms (23%), and low livestock productivity (20%) were other perceived effects of climate change reported by male heads of farm household. Female heads of farm household reported loss of livestock and crops to pests and diseases (32%), low livestock productivity (16%), reduced or loss of soil fertility (15%), and stopping the cultivation of certain crops (12%) as other effects of climate change.

With respect to effects of the long-term changes on household well-being, the study participants generally reported scarcity of food due to reduced yield or total loss of crops (88%), reduction in the number of meals eaten in a day (57%), loss of income due to yield losses (55%), poor health of household members (34%), and scarcity of fuelwood (17%).

From the key informant interviews and focus group discussions, it was clear that male and female heads of farm households were vulnerable to climate impacts. The extent of vulnerability to climate impacts depended on the ability to diversify livelihood activities by engaging in other income-generating activities. A key informant explained:

We have some female heads of farm households who are doing better than their male counterparts. You can have a female farm household head who has strong labor, has children, and trades or engages in other businesses. Such a person has a higher chance of taking proper care of the household than a male head of farm household who is aged, has no other job, or has no children. (KII 09)

## 5.7 Farmers' Perceived Challenges to Climate Change Adaptation

The factors enumerated by male and female heads of farm households are summarized in Table 2.5. The four topmost barriers identified by the female heads of farm households were lack of money (33%), lack of labor or labor-intensive adaptation practices (33%), lack of or inadequate access to extension delivery services (24%), and lack of information on available adaptation practices and weather (23%). Male heads of farm households enumerated lack of or inadequate access to extension (28), lack of money (19), old age or poor health (19), and lack of irrigation facilities (14%) as the four topmost barriers to adaptation.

It was observed that female heads of farm households had low income because they could not engage in other income-generating activities because they lacked capital. They mostly engaged in firewood sale and shea nut processing, which lack markets. Widows and single female heads of household mostly relied on exchanging labor and their children for farming activities. The inability of female heads of farm households to secure labor is mainly influenced by cultural beliefs or perceptions. A key informant made a succinct statement that illustrates this perception:

In our culture, it is men who are considered farmers. It is recently that NGOs and government officials have come to sensitize us and encouraged women to engage in farming to support their families. In our communities, women even don't own land and they don't even farm. If you see a woman farming, then maybe the husband died and left the land for her. Even then, the men who are laborers will prefer to farm for their fellow men because they believe that the women will be better than the men if they farmed for them. We believe that men are superior. (KII 09)

Table 2.5 Perceived Barriers to Climate Change Adaptation.

| Barriers                                                 | MHH (N =46)   | FHH (N =57)   | Total<br>N = 103 |
|----------------------------------------------------------|---------------|---------------|------------------|
|                                                          | Frequency (%) | Frequency (%) | Frequency (%)    |
| Lack of money                                            | 9 (19)        | 19 (33)       | 28 (27)          |
| Lack or inadequate access to extension                   | 13 (28)       | 14 (24)       | 27 (26)          |
| Lack of labor or labor-intensive strategies              | 7 (12)        | 19 (33)       | 26 (25)          |
| Lack of information on adaptation strategies and weather | 4 (9)         | 13 (23)       | 17 (16)          |
| Old age or poor health                                   | 9 (19)        | 9 (16)        | 18 (17)          |
| Lack of irrigation facilities                            | 8 (14)        | 2 (3)         | 10 (10)          |
| Others                                                   | 14 (30)       | 17 (30)       | 31 (30)          |

Results of the study suggest also that both males and females have equal access to extension services because government extension agents and nongovernmental organizations work with both male and female farmers. However, female farmers' availability for extension meetings was largely hindered by their role as primary caregivers.

## 6 DISCUSSION

The perceptions of farm household heads about changes in rainfall and temperature are important for planning crop farming activities and understanding farmers' decisions in the implementation of adaptation measures to secure their crops and livelihoods. In this study, male and female heads of farm households were aware of the changes in rainfall and temperature. Unreliable rainfall, late onset of rains, increasing temperature, increased dry spells, and stronger windstorms were observed to affect farming activities and household well-being in the Lawra district. These events, which can be associated with the changing climate, can significantly undermine the livelihood and lives of the already poor and vulnerable farmers in the district. These changing climatic impacts are consistent with findings by Armah et al. (2011), who reported delayed spring rains in the

Guinea Savannah agroecological zone and by Diiro et al. (2016), who observed increased temperature, droughts, and dry spells during the crop growing season in the semi-arid regions in Mali. Many of the farmers had no formal education. However, using indigenous knowledge, the farmers could report the indicators of changes in rainfall and temperature. As mentioned by Belay (2010) and Yaro (2013), indigenous knowledge is crucial to understand how long-term changes have affected the biophysical environment of local communities. Further, indigenous knowledge could be useful in planning interventions in areas where scientific data is absent. For example, anthropogenic activities, including bush burning and deforestation, are major activities perceived by the farmers to influence climate change, resulting in increased climatic impacts. Trees act as carbon sinks, taking up carbon dioxide from the atmosphere and minimizing climate impacts.

During bush burning and deforestation, the greenhouse gases carbon dioxide, methane, and water vapor get released into the atmosphere. These greenhouse gases absorb energy and prevent the loss of heat to space, resulting in increased temperature and other climate change impacts. This scientific view is consistent with the indigenous knowledge that bush burning and deforestation contribute to climate change. Thus, government and nongovernmental officials who provide extension services to farmers in rural communities can rely on indigenous knowledge from the farmers to help improve the activities of the farmers and their household well-being. Increasing bush burning and deforestation could affect crop production and ultimately impoverish farmers because, as temperature rises, the ability of the atmosphere to extract water from the ecosystem increases. This results in loss of soil moisture content and thus affects soil productivity. Education on good farming practices and sustainable use of forest resources could help improve farming and livelihoods in arid regions and enhance the resilience of the farmers to climate change impacts.

The gender of the household head partly influences the concern for climate change impacts on crop and livestock production activities. A study conducted by Nyantakyi-Frimpong and Bezner-Kerr (2015) observed that male farmers in two villages (Hemang and Jongorro) within the Upper West Region of Ghana were concerned about both climatic and non-climatic stressors, including floods, droughts, increased food prices, and lack of credit, while female farmers were more concerned about non-climatic stressors such as land, labor, and food insecurity. Empirical data reported by Antwi-Agyei et al. (2017) for the Central Gonja district in northern Ghana showed that both male and female farmers were more concerned about non-climatic stressors. In that study, male farmers were more concerned about lack of money, lack of agricultural equipment, and unemployment, and female farmers were more concerned about lack of drinking water, limited access to markets, and lack of money. In this study, male heads of farm households were more concerned about the impact of climatic stressors such as dry spells and erratic rainfall on their livelihood activities, and female heads of farm households were more concerned about non-climatic stressors such as lack of money and labor and limited access to markets. Therefore, adaptation intervention programs for farmers could be developed in line with their concerns about climatic and non-climatic stressors to livelihood risks. For example, adaptation intervention programs for male farmers in the Lawra district could focus on addressing the impacts of climatic stressors on livelihoods, while those of female farmers could deal with non-climatic stressors.

The lack of money among female farmers could lead to inability to hire labor. This can result in limited productive activities among the female farmers. Nonetheless, female farmers who have the financial capital to employ laborers (who are mostly male farmers) to support their farming activities are constrained by cultural beliefs and perceptions. This then limits the productive capacities of female farmers. Livestock production could be an alternative avenue for the female

farmers to generate income, but only a few of the female farmers owned livestock, probably because of a lack of financial capital and cultural norms. This situation could hinder female farmers' ability to generate income for investment in crop farming and household activities. Education could be very useful to undo cultural norms and improve the productive capacity of female farmers. This education should target both male and female farmers and their households. Jost et al. (2015) observed that male farmers in Doggoh in the Upper West Region of Ghana made farming decisions to maximize their profit. This observation could account for the reason why male farmers in present study were more concerned about the impact of climatic stressors – those climatic stressors affected their farming activities and reduced their yields. Female farmers had less concern for climatic stressors, probably because they primarily produce to feed the household and manage whatever yield was realized, even under adverse climatic events, to meet household food needs.

The differences in concern for impacts of climatic stressors on livelihood activities due to the gendered focus of farmers' production activities has implications for climate change adaptation intervention planning and development. A one-size-fits-all approach to climate change policymaking can overlook key gender dynamics, leading to maladaptation or non-adoption of interventions (Antwi-Agyei et al., 2017). Hence, stakeholders should ensure the inclusion of gender needs and perspectives in climate change adaptation strategies.

With agricultural production largely dependent on rainfall, any changes in rainfall during the cropping season can affect crop yields. Changing rainfall amounts, intensity, duration, and timing could have implications for household income, food security, and well-being. Unreliable rains and increased dry spells during the cropping season could result in total or partial crop losses that can significantly affect household food availability and income. As a coping strategy to food and

income losses, households reduce the number of meals consumed per day and decrease or forgo animal proteins because of their inability to afford them. This could lead to undernourishment and malnutrition, especially in young children. Further, loss of income due to climate change impacts on agriculture have implications on the ability of households to provide for other household needs.

Lost income can constrain the ability of households to pay for healthcare and educational needs of children. Inability of households to provide for educational needs of children (due to lost income) sometimes results in truancy or students completely dropping out. This situation could worsen illiteracy in the area. At present, northern Ghana has the lowest rate of literacy in the country. Similar to the views expressed by Armah et al. (2011), a plausible intervention could be the provision of small-scale irrigation systems to farm households to continuously supply water during the crop growing season. This intervention could boost yields and income while plans are made for the provision of a more sustainable water supply system, such as dams. In addition, agricultural extension agents and other agricultural development workers could, as part of their training programs, equip farmers with knowledge and skills about on-farm rainwater harvesting to help improve their productive capacity

Climate change impacts could erode gains made toward gender equality and sustainable development, particularly among communities where gendered access to resources and cultural norms continue to hinder the capacity of female farmers to engage in adaptation practices to reduce their vulnerability to climate change impacts. The empirical data from the Lawra district suggest that male and female heads of farm households faced similar challenges – money, inadequate access to extension, lack of information on available adaptation strategies, and weather – in their efforts to reduce climate change vulnerabilities. Female farmers, however, are also constrained by gender and cultural norms or perceptions. For example, females are not considered farmers or are

excluded from participating in decision-making processes in certain cultures. This situation can result in gendered access and entitlement to productive resources and affect the ability of female farmers to adapt to climate change impacts. Thus, it is important to incorporate the needs of both male- and female-headed households in climate change adaptation planning. Again, efforts at adaptation intervention planning should address cultural norms and perceptions that increase the vulnerability of female heads of households to climate change impacts. These efforts should aim to lessen the effects of gender norms and perceptions on household income, livelihood, and socioeconomic well-being. In addition, prioritizing access to productive resources, ownership, and control of assets in intervention programs could significantly improve the adaptive capacities of male and female heads of farm households.

## 7 CONCLUSION

This study explored farmers' perspectives on climate change and its impact on their farming activities and household well-being. A mixed-methods approach comprising key informant interviews, household surveys, and focus group discussions was employed to acquire empirical data from heads of farm households, local community leaders, and government officials in the Lawra district of the Upper West Region of Ghana. Key study findings are:

- No observable differences in climate perceptions between male and female heads of farm households.
- Climate change impacts on farming and livelihoods are mainly exacerbated by anthropogenic activities (bush burning and deforestation).
- Male heads of farm households are more concerned about the effects of climatic stressors on their livelihoods; female heads of farm households are particularly concerned about the effects of non-climatic stressors on their livelihoods and household well-being.

- Both male and female heads of farm households experience yield and income losses due to climate change impacts.
- Cultural norms and perceptions increase female farmers' vulnerability to climate impacts.
- Lack of money, lack of labor, inadequate extension services, lack of information on local climate, and lack of access to adaptation strategies are major constraints in reducing climate change impacts.

These findings have implications for climate change policy and adaptation planning. Incorporating gender perspectives of climatic stressors into climate change adaptation intervention planning and development could help improve the socioeconomic well-being of poor and underserved households. Gender norms and cultural perceptions have the potential to undermine the productive capacity of female farmers. In the author's view, education of all stakeholders can undo these norms and perceptions to improve household food security and well-being and increase the resilience of female farmers to adverse effects of climatic stressors. Additionally, education on sustainable management of forest resources could minimize vegetation depletion, contribute to climate change mitigation, and reduce the adverse impacts of climatic stressors on farm households.

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## CHAPTER THREE

### CLIMATE CHANGE COPING AND ADAPTATION PRACTICES OF SMALLHOLDER FARMERS: A CASE OF NORTHWESTERN GHANA

#### ABSTRACT

A mixed-methods approach – key informant interviews, household surveys, and focus group discussions – was employed to assess coping and adaptation measures adopted by male and female heads of farm households to counter climate change impacts on their livelihood activities and household well-being in the Guinea Savannah agroecological zone in Ghana. Additionally, the preferred institutional adaptation support of heads of farm households in adapting to future projected impacts was assessed. The gender of the head of household was found to influence the choice of coping and adaptation measures. Fewer female heads of farm households than male heads engaged in climate change adaptation measures. Female heads of farm households relied mainly on borrowed money from village savings and loans group as a coping measure; male heads of farm households depended primarily on sale of livestock. Varying planting and harvesting dates, crop diversification, and use of improved crop varieties were the major adaptation strategies adopted by the farmers to minimize climate change impacts. Provision of dams and/or dugouts, postharvest processing facilities, adaptation capacity-building resources, and improved access to markets and credit could enhance the adaptive capacity of male and female heads of farm households to mitigate projected climate change impacts on their livelihood activities and household well-being.

Key words: gender; climate change adaptation; agriculture; food security; farming

## 1 INTRODUCTION

The agricultural sector in West Africa employs 60% of the labor force. Farmers are mostly smallholder producers who face a myriad of challenges ranging from unavailable markets, inadequate access to inputs, insecure land tenure, decreasing farm sizes, increasing incidence of droughts, and decreasing soil fertility (Jalloh, Nelson, Thomas, Zougmore, & Roy-Macauley, 2013). Climate change projections of rainfall variations and increased incidence of extreme climatic events could add to these challenges because food production activities depend largely on rainfall (Nelson et al., 2010).

Agriculture remains the backbone of Ghana's economy, providing employment to more than 50% of the active labor force and supplying most of the national food requirements for the population (FAO, 2015). Climate change projections across the country point to increasing temperatures across all ecological zones with temperature during the lean season expected to increase by about 3°C by 2080. Projected changes in precipitation during the wet season are crowded with uncertainty (Stanturf et al., 2011). In northern Ghana, climate change models show decreasing trends in rainfall, increases in temperature, and increasing incidence of late onset of spring rains (Ndamani & Watanabe, 2015; Stanturf et al., 2011). These projected changes in rainfall and temperature could adversely affect agricultural production in the region, given that the region has only one rainy season and agricultural production depends excessively on rainfall. The probable effects of climate change on agriculture could include yield losses, loss of farm income, and reduced well-being of farm households (Jalloh et al., 2013; Rosenthal & Kurukulasuriya, 2003). These adverse impacts of climate change could also stifle efforts toward poverty reduction among rural dwellers who depend on agriculture and other climate-sensitive activities for their livelihoods and well-being. Stutley (2010) indicated that an annual average of 5.5% of total output of the major

staples – maize, rice, cassava, yams, millet, sorghum, groundnuts, and plantain – is lost to climatic, biological, and natural disasters in Ghana. Nyuor et al. (2016) found that increased temperature negatively affects revenues generated from crop production by farmers in northern Ghana. Thus, it is crucial for farmers to undertake adaptation strategies to help cushion them against the adverse impacts of climate change.

Farmers have been adapting to variability in precipitation and average temperature over several decades (Antwi-agyei, Stringer, & Dougill, 2014; Bawakyillenuo, Yaro, & Teye, 2016; Deressa, Hassan, & Ringler, 2011; Ndamani & Watanabe, 2015; Yaro, 2013). Bawakyillenuo, Yaro, and Teye (2016) found that farmers in northeastern Ghana engaged in crop and livestock diversification, intensification of irrigation, and diversification into nonfarm income-generating activities to improve their livelihoods. However, very little is known about the gendered nature of these adaptation practices at the farm household level. Farmers' ability to adapt to projected trends in rainfall and temperature partly depends on institutional support for adaptation. The institutional support must be gender-sensitive and designed to include farmers' preferences (Jost et al., 2015; Stanturf et al., 2011). Incorporating farmers' views into adaptation planning is important because literature suggests that the adverse impacts of climate change on agriculture will be felt unequally within the country (Goh, 2012). Climate change impacts are expected to differ across agroecological zones and among households because of differences in resources, which tend to influence adaptive capacity (Codjoe et al., 2012). Gender mainstreaming in climate change adaptation intervention planning is crucial given the gendered nature of climate change vulnerabilities (Alston, 2014; Nelson, 2010). Like males, females also have agency and important knowledge useful in climate adaptation intervention planning and development of strategies for tackling climate change impacts related to food security and household well-being (Alston, 2014).

Many studies have been conducted in Ghana to explore the linkages between gender and climate change adaptation in agriculture. These studies have focused on the gender dimensions of climate change vulnerabilities (Codjoe et al., 2012), the adaptation strategies adopted by farm households (Ahmed et al., 2016) to counter the adverse impacts of climate change, and the importance of adaptation strategies (Ndamani & Watanabe, 2015). There is a discussion on the need for provision of gender-sensitive institutional support to improve farmers' resilience to current variability in precipitation and temperature and to enable the farmers to effectively adapt to future climatic changes. The success of such intervention partly depends on understanding the perspectives of farm households on the effectiveness of current adaptation measures.

Using qualitative data from key informant interviews and focus group discussions and quantitative data from cross-sectional surveys of farm households in three communities in the Lawra district of Ghana, this study explored the coping and adaptation measures adopted by male and female heads of farm households to counter climate change impacts. The study also explored the perspectives of farmers on the effectiveness of current adaptation practices. Additionally, their preferred institutional support for adapting to future changes in rainfall and temperature, and the preferred sources for the adaptation support were assessed. This study aims to broaden understanding of gender perspectives on climate change adaptation and inform the development of adaptation strategies tailored to the preferences of farm households.

## 2 CLIMATE CHANGE ADAPTATION IN AGRICULTURE WITH A FOCUS ON GHANA

Many smallholder farmers in sub-Saharan Africa adjust their farm management practices to variations in the local climate and other factors such as unavailable markets, high input costs, and lack of infrastructure to secure their livelihoods (Kandlikar & Risbey, 2000). The projected impacts of climate change on agriculture require that farmers undertake coping and adaptation

strategies to minimize their vulnerability to the impacts (Lambrou & Nelson, 2010; Stanturf et al., 2011). Coping strategies are defined as short-term measures undertaken by farmers to deal with food or income shortages in abnormal cropping season or years (Davies, 1993). Farmers employ coping measures in an effort to minimize risk and vulnerability to food insecurity and loss of income due to threat from climatic and non-climatic stressors (Davies, 1993). Adaptation is “adjustments in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderate harm or exploit beneficial opportunities” (Intergovernmental Panel on Climate Change, 2007, p. 6). Adaptation to negative impacts of climate change is imperative because failure to adapt could lead to dire consequences such as loss of livelihood, social conflicts and displacement, and even death (Downing, Ringius, Hulme, & Waughray, 1997). Adaptation measures are meant to reduce vulnerabilities of individuals to adverse impacts of climate change while ensuring sustainability. Effective adaptation among farmers requires changes in processes, practices, and structures to achieve sustainable development (Smit et al., 2001).

Nhemachena and Hassan (2007) grouped farm-level adaptations into two categories: increased crop diversification, which involves the cultivation of species or cultivars that are tolerant to weather variations, and changes in farm management practices that ensure that critical crop growth stages do not coincide with unfavorable weather conditions. Crop diversification in agriculture has the potential to protect farm businesses from total crop failure because various crops respond differently to rainfall variations and related climatic events, and changes in farm management practices may reduce yield losses (Orindi & Eriksen, 2005). Increased use of irrigation, increased use of water and soil moisture conservation techniques, and diversification to non-farm activities have also been employed as adaptation measures (Antwi-Agyei, Stringer, & Dougill, 2014; Hisali, Birungi, & Buyinza, 2011; Kansiime & Mastenbroek, 2016).

Bawakyillenuo, Yaro, and Teye (2016) found that farmers adopted changes in tillage practices and intensification of irrigation to counter the adverse effects of variability of rainfall and temperature on their production activities in northeastern Ghana. Fosu-Mensah, Vlek, and MacCarthy (2012) found that farmers in southern Ghana engaged in diversification of income generation activities during the dry season and varied their planting and harvesting dates with the goal of reducing the negative impacts of climate change. Absent in the scholarly discourse is farmers' perspectives on the effectiveness of the identified adaptation measures in mitigating climate change impacts.

Adaptation, to a large extent, depends on the farmers' adaptive ability to counter the impacts and risks of climate change. This adaptive ability is influenced by their socioeconomic characteristics (Smit et al., 2001). Some researchers have argued for institutional support to enable farmers to adapt to current and future variations in climate and to improve their resilience (Antwi-Agyei et al., 2013; Rosenthal & Kurukulasuriya, 2003; Stanturf et al., 2011). According to Rosenthal and Kurukulasuriya (2003), the support could be provided by government agencies, nongovernmental organizations, and other stakeholders in agriculture. Examples of support include providing community irrigation systems, resourcing research institutions to develop climate-tolerant crop varieties, providing agricultural insurance, building capacity of farmers, creating opportunities for stable income, and providing credit and extension services (Fosu-Mensah et al., 2012; Rosenthal & Kurukulasuriya, 2003; Yaro, 2013).

Incorporating grass-roots perspectives and accounting for gender perspectives in planning institutional support for farmers are critical because men and women farmers may face different constraints to adaptation and prefer different types of adaptation support due to differences in adaptive capacities and roles (Codjoe, Atidoh, & Burkett, 2012; Diiro et al., 2016; Jost et al., 2015). Codjoe et al. (2012) in their study demonstrated that men and women farmers differed in their

preferences of support for adaptation. For example, female farmers preferred wells and boreholes, bushfire control, and water harvesting, while male farmers preferred irrigation, wells, boreholes, and drought-tolerant crop varieties in adapting to drought conditions. Similar observations were made by Jost et al. (2015), who assessed adaptation practices among farmers in Uganda and Ghana. Adaptation intervention preferences among farmers at the household level, however, are yet to be studied. Thus, this study relies on empirical data from northwestern Ghana to assess the adaptation intervention preferences of male and female heads of farm households to mitigate climate change impacts.

### 3 METHODS

#### 3.1 Study Area

The study focused on three communities—Mettoh, Kasalgri, and Tabier—in the Lawra district of the Upper West Region of Ghana. The Lawra district lies within the Guinea Savanna agroecological zone, which is classified as semi-arid and is characterized by two seasons: the dry season (November to April) and the wet season (May to October) (Ndamani & Watanabe, 2015). According to the Ghana Statistical Service (2014), about 88% of the district's population of 54,889 live in rural communities, and about 90% of the rural households are engaged in agriculture. Most households are into crop farming and livestock rearing. There are slightly more females (52%) in the district than males (48%). Vegetation in the district is characterized by short grasses and few woody plants (Ndamani & Watanabe, 2015; Ghana Statistical Service, 2014).

The nature of the soils, together with frequent droughts, dry spells, and floods, tends to adversely affect crop production with implication for household food security in the district (Ghana Statistical Service, 2014). The main crops produced by farmers are maize, millet, groundnuts, soya bean, and cowpea. The majority of the crop production activities are done in the rainy season

because agriculture in the district is mostly rain-fed and at the subsistence level (Ndamani & Watanabe, 2015). For these reasons and the increasing number of female-headed farm households in the district (Ahmed, et al., 2016), the district was chosen to explore the objectives of this study.

### 3.2 Data Collection

The study was designed to cover male and female heads of farm households from three communities (Mettoh, Kasalgri, and Tabier) in the Lawra district of the Upper West Region of Ghana. The data collection was carried out in three phases – key informant interviews, a household survey, and focus group discussions. The first phase involved key informant interviews with traditional leaders and agricultural workers in the district. Purposive sampling was used to select the participants for the key informant interviews. This sampling procedure was used because it allows the collection of information from participants who are well versed in the phenomenon under investigation (Babbie, 2010). A total of nine key informant interviews were conducted. Two key informant interviews involving a male and a female were conducted in each community; three were with agricultural workers in the district. An interview guide was used in soliciting information from the key informants. The key informant interviews explored how agriculture has been affected by changes in climate from 2006 to 2016. It also assessed practices that build households' resilience to climate change and identified institutional interventions to help households cope and adapt to future climate impacts.

The second phase of data collection involved a survey of households in the study communities. The survey instrument was developed on the basis of a literature review on climate change adaptation practices among smallholder farmers. The survey was designed to measure the sociodemographic characteristics of farmers, current climate change coping and adaptation practices, the perceived effectiveness of current adaptation strategies, farmers' preferred

institutional supports for future adaptation, and the sources of these supports. The list of adaptation strategies covered those implemented by the farmers to reduce crop losses and to provide an alternative source of income for the households. A mix of open-ended and Likert-type questions was used. The households were selected with the assistance of a community person. The following criteria were used in selecting households to participate in the study: male-headed, with one or more wives; male-headed, divorced, single, or widowed; female-headed, divorced, single, or widowed; female-headed, husband or partner away, husband/partner makes most household and farm decisions; and female-headed, husband/partner away, wife makes most household and farm decisions. Convenience sampling was used in selecting household heads. This sampling procedure was used because at the time of data collection (June 2017), farmers were busy with land preparations and planting activities. A total of 124 farm household heads participated in the study; 68 of these were females. The survey was administered in a face-to-face interview with the help of enumerators drawn from the Lawra office of the Ministry of Food and Agriculture, and Women in Agriculture Development. The enumerators were taken through a two-day training program to acquaint them with relevant skills to administer the survey to participants. Before commencement of the survey, the survey instrument was pretested to ensure suitability of the instrument to the local context. Feedback from the pretesting was used to fine-tune and finalize the survey instrument.

The final phase of data collection consisted of five focus group discussions. Two focus groups – one for males only and one for females only – were conducted in both Kasalgri and Mettoh. The fifth focus group was conducted for both males and females from the Tabier community. In each community, invitation was extended to 12 men and 12 women. A total of 54 farmers participated in the focus group discussions – 26 males and 28 females (Table 3.1). The focus group participants

were purposively selected with the help of a local person. The criteria for selection were a person's availability and willingness to participate in the process as well as the type of farm household (male- or female-headed) each represented. A focus group discussion guide was used in the data collection process. A translator was used to translate the questions and responses from English to the local language and the local language to English, respectively. All the interviews and focus group discussions were audio recorded with permission from participants and later transcribed for processing and analysis.

Table 3.1 Communities Visited and Focus Group Sample Size.

| <b>Community</b> | <b>Number of males<br/>(N=26)</b> | <b>Number of females<br/>(N = 28)</b> | <b>Total<br/>(N = 54)</b> |
|------------------|-----------------------------------|---------------------------------------|---------------------------|
| Mettoh           | 7                                 | 8                                     | 15                        |
| Kasalgri         | 9                                 | 12                                    | 21                        |
| Tabier           | 10                                | 8                                     | 18                        |

### 3.3 Data Analysis

The qualitative data from the interviews and focus group discussions were analyzed after codes and themes were identified using open coding (Beotto & Mckinnon, 2013). Similar themes identified during the coding process were merged into one theme. The quantitative data generated from the household surveys were analyzed using descriptive statistics such as means, standard deviations, crosstabs, frequencies, and percentages using SPSS, version 22.

## 4 RESULTS

This section presents the coping and adaptation measures adopted by farm household heads to counter climate change impacts and the perceived effectiveness of current adaptation practices. In addition, it reports the preferred institutional adaptation supports of male and female heads of farm households required for mitigating climate change impacts.

#### 4.1 Sociodemographic Characteristics of Study Participants

As shown in Table 3.2, slightly more than half (55%) of the study participants were female heads of farm households. There were slightly more male heads of farm household with one or more wives (42%) than de jure female heads of farm households (32%) and de facto female heads of farm households (23%). About 3% of the male heads of farm households were single, divorced, or widowed. More males than females had had some form of formal education. About 25% of the male respondents had some form of formal education, with the highest level of education being a university degree (2%). Among female participants, 12% reported having attained some form of formal education, with the highest level of education being basic education (3%).

Table 3.2 Sociodemographic Characteristics of Study Participants.

| Characteristics                   | Male heads of households (N = 56)<br>Percent reporting | Female heads of households (N = 68) |
|-----------------------------------|--------------------------------------------------------|-------------------------------------|
| Native                            | 100                                                    | 57                                  |
| Livestock ownership               | 98                                                     | 78                                  |
| <b>Type of household</b>          |                                                        |                                     |
| Male (with one or more wives)     | 42                                                     | 0                                   |
| Male (single or widowed)          | 3                                                      | 0                                   |
| De jure female head               | 0                                                      | 32                                  |
| De facto female head              | 0                                                      | 23                                  |
| <b>Highest educational level</b>  |                                                        |                                     |
| Some basic school                 | 13                                                     | 9                                   |
| Basic school                      | 7                                                      | 3                                   |
| High school                       | 4                                                      | 0                                   |
| Tertiary                          | 2                                                      | 0                                   |
| <b>Type of group membership</b>   |                                                        |                                     |
| Village savings and loans         | 30                                                     | 65                                  |
| Other*                            | 16                                                     | 4                                   |
| <b>Type of farmland ownership</b> |                                                        |                                     |
| Owner                             | 96                                                     | 47                                  |
| Other**                           | 4                                                      | 53                                  |

\* = religious group; women's group; farmer-based organizations

\*\* = husband's land; father's land; brother's land; renting or sharecropping

About 69% of female heads and 46% male heads of farm household were part of a group in the community. There were more male heads of farm households (16%) who had access to formal credit than female heads of farm households (1%). About 47% of the female heads of farm households owned their farmland. Other female heads secured their farmland through their fathers, brothers, or husbands, or by renting/sharecropping (53%). A majority (96%) of the male heads of farm households owned their land; the remaining secured their farm lands through sharecropping or allocation from their fathers (4%). The findings on land ownership reflect cultural practices in the area, where lands are customarily owned by male heads and passed on to their sons. A woman can assume temporary ownership of farmland with permission from a brother-in-law upon the death of a husband, but she will have to return ownership to the husband's family when she returns to her family or transfer ownership to her first son when he reaches adulthood. All the male heads were natives, and 57% of the female heads of households were natives. More male-headed farm households (98%) than female-headed farm households (78%) owned livestock. Goats, chicken, pigs, sheep, and guinea fowl were some of the livestock reared by farm households.

#### 4.2 Measures Adopted by Households to Cope with Effects of Climate Change

The coping measures adopted by male and female heads of farm households to deal with low food and income availability (due to impacts of climate change on their livelihood activities) are shown in Figure 3.1. There was a gendered pattern to the coping measures adopted by households to counter the negative impacts of the climatic stressors. The four topmost activities adopted by female heads of farm household were borrowing money from friends, relatives, or village savings and loans group (45%); selling wild fruits and vegetables (29%); selling firewood and/or processing shea nuts (19%); and selling livestock (18%). The female heads of farm households increasingly engaged in these coping activities during the dry season because of lack of alternative

livelihood options and economic opportunities. Another reason for these activities was their inability to raise the needed capital to undertake other livelihood options such as beekeeping and pastry and soap making. They had to use the little money obtained from farming or borrowing to support their families. In addition, husbands must give permission to de facto female heads of farm household before they could sell livestock to meet household needs because women in the communities were not considered as owners of the household livestock.

Male heads of farm households sold livestock (45%), migrated to look for jobs (21%), borrowed money from friends, relatives and/or village savings and loans group (21%), or managed whatever the household was able to harvest during the cropping season (16%) to counter the impacts of climatic shocks. Migration in search of alternative livelihoods has partly been driven by unreliable rainfall and increasing incidence of dry spells and drought in the communities. Many male heads of farm households indicated that temporary migration down south for jobs is a crucial coping measure.

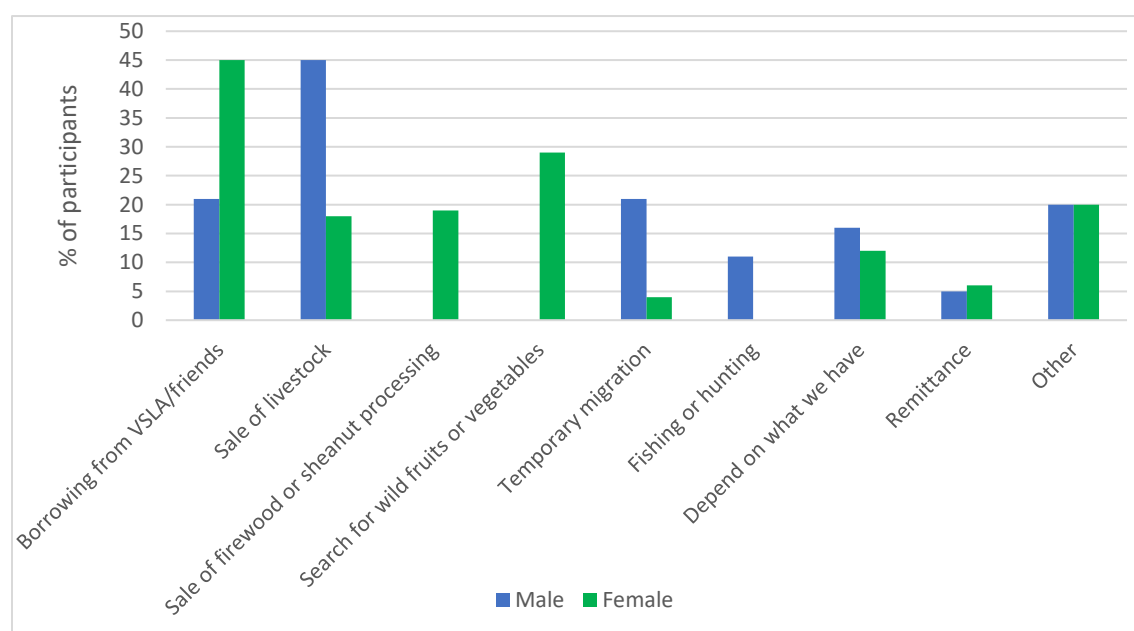


Figure 3.1. Measures for Coping with Adverse Climate Impacts.

#### 4.3. Farmers' Adaptation Strategies to Mitigate Climate Change Effects

All study participants reported changes in rainfall and temperature, and about 84% of study participants implemented adaptation measures to counter the impact of the climatic shocks on their cropping activities (Table 2.3). Among female heads of farm households, 75% implemented adaptation strategies to improve their resilience to adverse effects of climate and climatic events. Likewise, 95% of male heads of farm households implemented some form of adaptation strategy to secure their well-being.

Changing crop planting and harvesting dates (77%), water and soil moisture conservation practices (69%), soil fertility conservation practices (68%), use of improved crop varieties (61%), and crop diversification (59%) were the common adaptation strategies implemented by both male- and female-headed households. Other important but less commonly practiced adaptation strategies included planting of trees or fruit trees (55%), diversification into non-farm activities (43%), dry season gardening (36%), and use of irrigation (27%). Generally, male heads of farm household were more engaged in adaptation practices than females, except for diversification into non-farm activities.

A few female heads of farm households compared to their male counterparts engaged in adaptation strategies such as water and soil moisture conservation practices (ridging, stone or earth bunding) because they are labor-intensive. Additionally, they are unable to secure labor for these practices because of cultural norms, the location of their farms, the type of land tenure, and the types of crops they cultivate.

Table 3.3 Farmers' Adaptation Strategies for Mitigating Climate Change Impacts.

| Adaptation options                             | MHH (N =53)<br>Frequency (%) | FHH (N =51)<br>Frequency (%) | Total (N = 104)<br>Frequency (%) |
|------------------------------------------------|------------------------------|------------------------------|----------------------------------|
| Use of improved crop varieties                 | 45 (80)                      | 30 (44)                      | 75 (61)                          |
| Crop diversification                           | 47 (84)                      | 26 (38)                      | 73 (59)                          |
| Soil fertility conservation practices          | 49 (87)                      | 35 (51)                      | 84 (68)                          |
| Water and soil moisture conservation practices | 49 (87)                      | 36 (53)                      | 85 (69)                          |
| Changing planting and harvesting dates         | 50 (89)                      | 46 (68)                      | 96 (77)                          |
| Planting of trees or fruit trees for shade     | 43 (77)                      | 25 (37)                      | 68 (55)                          |
| Dry season gardening                           | 28 (50)                      | 17 (25)                      | 45 (36)                          |
| Use of irrigation                              | 22 (39)                      | 11 (16)                      | 33 (27)                          |
| Diversify into non-farm activities             | 25 (45)                      | 29 (43)                      | 54 (43)                          |

#### 4.4 Farmers' Perceived Effectiveness of Current Adaptation Practices

The perceptions of male and female heads of farm households of the effectiveness of current adaptation practices in mitigating climate change impact are shown Table 3.4. Generally, both male and female heads of farm households perceived the adaptation measures to be effective in helping them reduce the adverse effects of variations in rainfall and temperature and extreme climatic events. The adaptation measures had an average score above 3 (somewhat effective). Both male and female heads of farm households agreed that the use of improved varieties (early-maturing and drought-tolerant varieties) and the implementation of soil fertility conservation practices were helpful in countering the adverse effects of climate change on crop production. Other adaptation measures that were rated as being effective in helping farm households withstand climate change impacts included water and soil moisture conservation practices, use of irrigation, crop diversification, and dry season gardening.

Table 3.4 Farmers' Perceptions of the Effectiveness of Adaptation Strategies.

| Adaptation measure                      | Male heads of households (N = 56) | Female heads of households (N = 68) | Total (N = 124) |
|-----------------------------------------|-----------------------------------|-------------------------------------|-----------------|
|                                         | Mean (SD)                         | Mean (SD)                           | Mean (SD)       |
| Improved varieties                      | 4.60 (.49)                        | 4.60 (.50)                          | 4.60 (.49)      |
| Soil fertility conservation practices   | 4.33 (.72)                        | 4.31 (.58)                          | 4.32 (.66)      |
| Water and soil moisture conservation    | 4.39 (.64)                        | 3.97 (.81)                          | 4.21 (.74)      |
| Use of irrigation                       | 4.36 (.58)                        | 3.73 (.65)                          | 4.15 (.67)      |
| Dry season gardening                    | 4.29 (.76)                        | 3.88 (.48)                          | 4.13 (.69)      |
| Crop diversification                    | 3.91 (.80)                        | 3.96 (.60)                          | 3.93 (.73)      |
| Changing planting and harvesting dates  | 4.12 (.75)                        | 3.40 (.86)                          | 3.78 (.88)      |
| Planting trees or fruit trees           | 3.91 (1.09)                       | 3.28 (.74)                          | 3.68 (1.01)     |
| Diversification into nonfarm activities | 3.52 (1.12)                       | 3.45 (.63)                          | 3.48 (.88)      |

Scale: 1= Not effective, 2 = Less effective, 3= Somewhat effective, 4 = Effective, 5 = Very effective.

Although considered effective in countering climate change impacts on livelihood and household well-being, staggering crop planting and harvesting dates, planting trees or fruit trees, and diversifying into nonfarm activities were rated lower among female heads of farm households than among male heads of farm households. In the focus group discussions and key informant interviews, participants indicated that although non-farm activities are good alternatives for income generation, the capital-intensive nature of the available options and lack of markets constrained their ability to adequately benefit from such activities.

#### 4.5 Farmers' Sources and Types of External Support to Cope with Climate Change Impacts

About 44% of the farmers indicated that they received some form of support from external sources to cope with climate change impacts. About 19% of these farmers received support from relatives, 26% from nongovernmental organizations, and 2% from government agencies. Among male heads of farm households, 27% received support from relatives. Out of these, 12% received food; 9%,

soft loans; 1%, farm input support; and 4%, money. About 27% of male heads of farm households received support from nongovernmental organizations. Of these, 9% received small ruminants; 23%, improved seeds; 2%, healthcare; and 5%, others (e.g., fertilizer). A few (2%) received irrigation pipes from government agencies as support to cope with climate change impacts. Among female heads of farm households, 13% received support from relatives. About 10% received food; 2%, soft loans; and 1%, farm inputs from relatives. Further, 25% reported receiving support from nongovernmental organizations. Of these, 18% received small ruminants, 13% received farm inputs (seeds), and 3% received soft loans from the NGOs.

The data indicate that the main source of external support for both types of households was NGOs. This NGO support was free and aimed to help the households to diversify their income sources and to improve their resilience to the impacts of climate change.

Even though some of the farmers received support from relatives, they indicated the need for an urgent intervention from external agencies to cope with climate change impacts and improve their food security. Specifically, participants indicated that they needed help with food, healthcare facilities, farm inputs, small ruminants, and credit. They stressed the need for the provision of grants or some form of safety net to vulnerable members of the population, which included the aged, widows, widowers, and persons with disabilities.

The qualitative analysis shows that farmers were engaged in collective action toward climate change mitigation. Specifically, in all the study communities, volunteer groups monitored the activities of other community members to prevent indiscriminate tree cutting and bushfires. In two of the communities (Mettoh and Kasalgri), for example, there were bylaws to curb indiscriminate tree cutting and bush burning.

#### 4.6 Preference for Institutional Adaptation Support

The preferred list of potential institutional interventions of male and female heads of farm households for improving their adaptive capacity, along with their respective rankings, is shown in Table 3.5. Both male and female heads of households showed a preference for institutional adaptation interventions. Both male and female heads of households ranked provision of dams or dugouts and improved access to credit as the top two preferred institutional supports for adapting to changes in climate.

Table 3.5 Farmers' Preferred Institutional Support for Adaptation.

| Adaptation measure                                                     | Male heads of households<br>(N = 56) | Rank            | Female heads of households<br>(N = 68) | Rank            |
|------------------------------------------------------------------------|--------------------------------------|-----------------|----------------------------------------|-----------------|
|                                                                        | Mean (SD)                            |                 | Mean (SD)                              |                 |
| Provision of dams or dugouts                                           | 2.93 (.26)                           | 1 <sup>st</sup> | 2.84 (.37)                             | 1 <sup>st</sup> |
| Improved access to credit                                              | 2.84 (.46)                           | 2 <sup>nd</sup> | 2.66 (.59)                             | 2 <sup>nd</sup> |
| Farmer adaptation capacity building through extension education        | 2.84 (.37)                           | 2 <sup>nd</sup> | 2.47 (.58)                             | 4 <sup>th</sup> |
| Grants or price support to farmers to cover crop or livestock loss     | 2.80 (.40)                           | 5 <sup>th</sup> | 2.47 (.50)                             | 4 <sup>th</sup> |
| Provision of seasonal forecast or community weather monitoring station | 2.77 (.43)                           | 6 <sup>th</sup> | 2.47 (.65)                             | 4 <sup>th</sup> |
| Provision of postharvest processing technology/                        | 2.71 (.49)                           | 7 <sup>th</sup> | 2.51(.50)                              | 3 <sup>rd</sup> |
| Improved access to market                                              |                                      |                 |                                        |                 |
| Grain bank or storage facility                                         | 2.82 (.39)                           | 4 <sup>th</sup> | 2.31 (.61)                             | 7 <sup>th</sup> |
| Improvement in access to and ownership of land                         | 2.54 (.69)                           | 8 <sup>th</sup> | 2.43 (.65)                             | 8 <sup>th</sup> |

Scale: 1 = Not preferred at all 2 = Less preferred 3 = Most preferred.

Other types of adaptation support preferred among female heads of farm households included provision of postharvest processing technology and improved access to market, provision of grants

or price support to farmers to cover crop and or livestock loss to climatic stressors, increased extension education focused on equipping farmers with requisite information and skills for building their adaptive capacity, and the provision of seasonal forecast or a weather monitoring station.

Male heads of farm households showed preference for adaptation capacity building through extension education, provision of grain banks or storage points, grants or price support to farmers to cover crop or livestock loss to climatic stressors, and the provision of seasonal forecasts or a community weather monitoring station.

#### 4.7 Farmers' Preferred Sources of Institutional Support

The preferred sources of institutional support for adapting to the negative impacts of climate change of male and female heads of farm households are presented in Figure 2.2. The top three sources of institutional support for adaptation were NGOs, national government or research institutions, and local government institutions.

Notably, more female than male heads of farm households preferred to receive support for adaptation from their local government agencies and fellow farmers. Both male and female heads of farm households showed less interest in receiving support for adaptation from community self-help groups.

From the focus group discussions and key informant interviews, it was obvious that current support for adaptation and coping measures was mostly provided by NGOs. Farmers in the three study communities mentioned that various NGOs had provided households with livestock, seeds, fertilizers, and training in alternative livelihood options to build their resilience to climate change impacts.

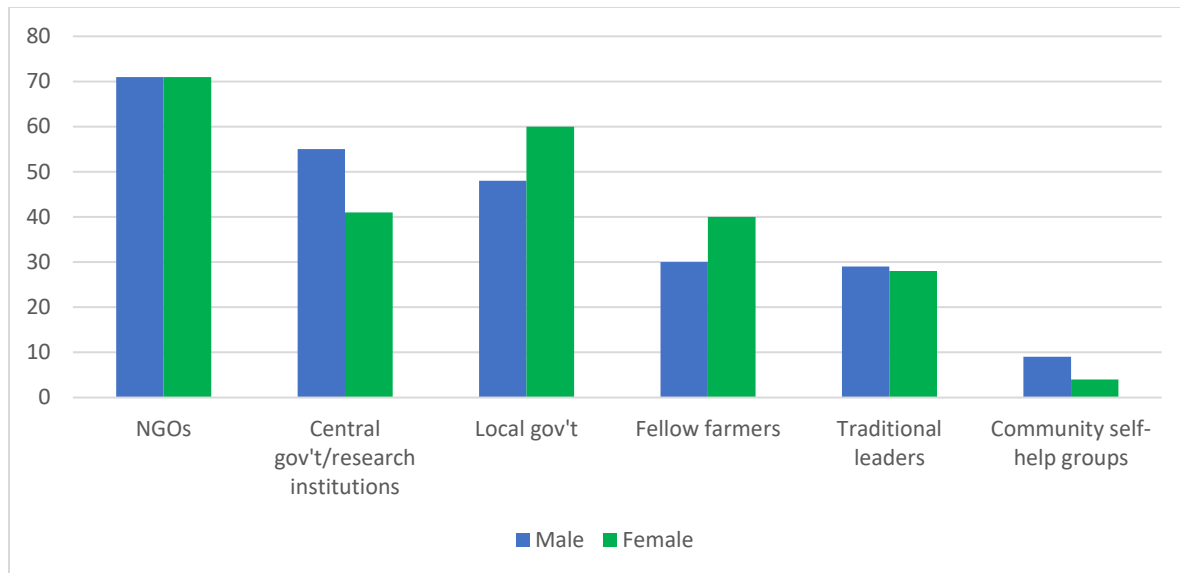


Figure 3.2 Farmers' Preferred Sources of Institutional Support

## 5 DISCUSSION

The results of the study demonstrate that both male and female heads of farm households have been adopting a myriad of coping measures to ensure household food security and to improve their financial status to counter the impact of climate change during abnormal cropping seasons. These results corroborate those of other studies that have reported that male and female heads of farm households adopt a range of strategies to reduce the vulnerability of their livelihoods and household well-being to climatic shocks (Diirro et al., 2016; Jin, Wang, & Gao, 2015; Wrigley-Asante, Owusu, Egyir, & Owiyo, 2017). The results suggest a gender dimension in the coping measures adopted by heads of farm households to reduce climate change impacts. For example, the key coping practices among female heads of farm households were borrowing from village savings and loans group, relatives, and sale of shea butter and forest resources such as firewood. Male heads of households relied instead on sale of livestock, forest resources, and temporary migration in search of jobs to meet household food and economic needs. These coping measures are commonly practiced among rural households that rely on climate-sensitive activities for their

livelihoods to increase food availability and income when they experience climatic shocks on their livelihoods.

It is evident that both male and female heads of farm households depend on forest resources as coping and adaptation measure. Female heads of farm households depend on cutting and selling trees (for firewood) as a coping measure for climate change impacts; male heads of farm households primarily depend on game, sometimes setting fire to the forest during hunting. The reliance of households on sale of forest products as a coping mechanism could worsen the state of forest depletion and increase climate change impacts, and thus increase incidence of water shortages and severe droughts. Such a situation could present food security and income challenges to rural households that depend on rain-fed agriculture. Additionally, increasing depletion of the forest could affect availability of fodder for livestock. Alternative livelihood activities and improved farming practices can improve the economic potential of the farmers, minimize their dependence on forest resources, and control forest depletion. Even though government enactments prohibit forest fires and indiscriminate tree cutting, the enactments are poorly and unevenly enforced by mandated government agencies. The lack of enforcement can partly be attributed to lack of resources such as logistics, human and financial capital, and technical resources. Thus, provision of adequate resources by authorities and enforcement of laws could help improve the sustainability of forest resources in the arid region. Additionally, intervention programs could focus on strengthening existing community initiatives on sustainable use of forest resources through collaborations with external agencies involved in programs on sustainable use of forest resources.

Migration of male farmers in search of wage jobs to raise income to improve food security and economic status of their households could be a plausible alternative measure for climate change

impacts adaptation. The absence of the male heads of households from their homes, however, could put emotional and psychological strain on their marriages or families. In addition, the migrant male farmers typically engage in nomadic livelihood activities (such as informal artisanal mining) and often brave hazardous conditions to earn meager incomes, a situation that can potentially affect their health and well-being.

Climate-related shocks in rain-fed agricultural production present significant risk to household income generation and food security. Thus, it is crucial for farm households to adjust their practices to counter the adverse impacts of climatic shocks. Consistent with findings by Tambo and Abdoulaye (2013), farmers in northwestern Ghana adopted both farm- and nonfarm-level adaptation measures to secure their livelihoods. The top adaptation practices of farmers included changing crop planting and harvesting dates, crop diversification, soil fertility improvement practices, and use of improved crop varieties. These adaptation measures aim to improve yields and minimize crop losses, thereby improving food security status and socioeconomic well-being of the rural farm households. Relying on drought-tolerant and improved crop varieties could also ensure the economic sustainability of the farm households. Education on adaptation techniques is necessary in ensuring that the right technique is applied at the appropriate time. This education should focus on both male and female farmers, including extension service providers, and should also aim to encourage male farmers to assist female farmers in obtaining labor needed to undertake adaptation measures. Female farmers could also be trained and encouraged to adopt climate-smart push-pull adaptation strategies that are considered less labor-intensive. For example, intercropping drought-tolerant trap plant (*Brachiaria* spp.) with drought-tolerant *Desmodium intortum* (green leaf desmodium) in Uganda, Kenya, Tanzania, and Ethiopia (Murage et al., 2015) improved soil fertility and minimized pest and weed infestations. Studies about the feasibility of employing

similar or alternative techniques could be adopted in northeastern Ghana to improve adaptation and farming practices. Gender and cultural norms undermine the abilities of female farmers to expand their farm production by discouraging or preventing male farmers from working for female farmers or excluding female farmers from important decision-making processes. Agricultural extension education programs could integrate topics focused on engendering behavioral and perception change, particularly among male farmers on the role of female farmers in agriculture, household food security, and well-being.

Understanding the perspectives of male and female farmers about the effectiveness of current climate change adaptation practices is useful for planning future adaptation interventions. Murage et al. (2015) indicated that female farmers favored less labor-intensive adaptation measures than males. In this study, male farmers considered current adaptation measures as effective in mitigating climate change impacts on their livelihood activities and household well-being. The unavailability of markets or reduced access to markets and credit by rural households that would like to diversify into nonfarm activities has the potential to prevent households from benefitting from the opportunities associated with nonfarm activities. Building an asset base for vulnerable households could improve their resilience to climate change impacts. For example, households could be provided with small ruminants or fowls to rear for food security. In addition, policy interventions targeted at improving farm households' access to cash and input credit could be instituted to improve their livelihood activities. Compared with male heads of farm households, females gave a lower rate to planting trees or fruit trees as an effective adaptation strategy. As observed in other studies in the Upper West Region of Ghana, female farmers showed preference for adaptation measures that have benefits that could be realized in the short run because of the constraints they faced in accessing productive resources such as land and labor (Jost et al., 2015; Nyantakyi-

Frimpong & Bezner-Kerr, 2015). Perhaps this explains why female heads of households showed interest in adaptation measures that yield food security and income within a relatively short period. This suggests the need for incorporating gender-based assessment of climate change adaptation in planning for adaptation interventions.

In this study, farmers received food, farm input support, livestock, and soft loans from NGOs and relatives to adapt to climate change. This external support is crucial to improve household food security status and asset base in a changing climate.

Transformation of the agricultural sector from rain-fed to both rainfed and irrigation-based could significantly ensure the adaptation of farmers to climate change impacts. Credit constraints in expanding farming activities and diversifying into nonfarm income-generating activities are also barriers to adaptation among farm households. Therefore, the transformation process could include the provision of dams and dugouts, and improved access to credit. This suggestion agrees with suggestions by Stanturf et al. (2011), who indicated that provision of irrigation systems to communities in northern Ghana is important to enable farmers to adapt to increasing variability in rainfall and temperature during the crop growing season. Improving access to credit could improve farmers' capacity to engage in other income-generating activities and enable them purchase farm inputs that are critical for adapting to the changing climate.

Female heads of farm households preferred postharvest processing technology and improved access to markets, but male heads of farm households preferred farmer adaptation capacity building through extension education. Conventionally, females engage in processing and marketing of agricultural produce in most farm households. At present, agricultural crops are mostly sold in their raw state, often resulting in low income because of a glut on the market. Provision of processing facilities could help female farmers to curb crop losses during storage and

increase the income gained by selling processed products. On the other hand, building male farmers' adaptive capacity through extension could improve their production levels and address their concern with making the most profit from their crop and livestock production activities. These differences in preference for institutional support stress the importance of incorporating gender perspective in adaptation intervention planning to reduce or prevent maladaptation.

Goh (2012) suggests that access to land is a barrier to climate change adaptation. It was observed in this study that land access may not be a major barrier to climate change adaptation in northern Ghana. Improved access to and ownership of land for farming was a least preferred institutional support for adapting to climate change impacts among farmers in the three northwestern communities in Ghana. A similar observation was made by Antwi-Agyei et al. (2017) among farmers in the Central Gonja district of northern Ghana. Thus, land rights and ownership formalization are not a crucial concern of the farmers. Findings from the qualitative process suggest that lands for farming in the study area are not sold but rather allocated by the family head (usually a man) to whoever asks for it for farming. Perhaps the low preference for improvement in land access and ownership could be due to land allocation arrangements that allow household heads to plan for crop rotation and fallowing each cropping season (Naylor, 1999). Permanent ownership of land by other individuals in the household could disrupt those farming plans. Although access to land has been identified as a major constraint to adaptation efforts of female farmers (Doss et al., 2011), in this study females have less preference for improvement in land access and ownership. More de jure female heads of households, however, have strong preference for improved land access and ownership. Thus, development efforts could be focused on encouraging males to make land available to de jure female heads of household.

It is evident that farm household needs, and perspectives should be incorporated in the identification and design of adaptation practices. Adaptation intervention planning can focus on designing and identifying measures (e.g., provision of irrigation facilities) that could transform agricultural production. A transformation of the agricultural sector from rain-fed to irrigation-based could result in increased productivity and improved household food security and economic gains. With agro-processing industries, increased productivity could provide employment and reduce the rate of male migration from the communities.

Farm households need institutional support to enable them to effectively adapt to adverse impacts of climate change. The farmers in this study preferred support from external agencies, but continuous overreliance on external support from agencies could cause the farmers to lose sight of their own abilities to develop local solutions to their problems. Therefore, it is important for institutions involved in developing adaptation interventions for communities to work in a bottom-up approach to identify locally suited strategies to prevent maladaptation. Such institutions could work with communities to identify assets such as social capital (e.g., informal networks and local associations) to create local economic opportunities for livelihood transformation and sustainable development.

## 6 CONCLUSION

This study assessed the climate change coping and adaptation measures adopted by male and female heads of farm household to reduce vulnerability to adverse impacts of climate change. The study further examined the perceptions of farm household heads on the effectiveness of current climate change adaptation practices and their preference for institutional support for adapting to climate change impacts. The key observations in this study are:

- Male and female heads of farm households mainly engage in borrowing from village savings and loans group, sale of forest products, sale of livestock, and temporary migration as coping measures to reduce the impact of climatic shocks on their livelihood activities.
- More male heads than female heads of farm households engage in climate change adaptation practices.
- Both male and female heads of farm households perceived current adaptation practices as effective in reducing the effects of adverse climate change impacts on their livelihoods and household well-being.
- The most preferred types of potential institutional adaptation support for both male and female heads of households are dams, dugouts, and improved access to credit.
- NGOs and government agencies were the most preferred source of institutional support for climate change adaptation.

The findings in this study have implications for climate change mitigation and adaptation planning. Engagement of agricultural extension agents, forestry officers, and community members in sustainable use of forest resources and reforestation could enhance food security and income generation among households. Further, less labor-intensive adaptation practices could improve the resilience of farmers to adapt to climate change impacts.

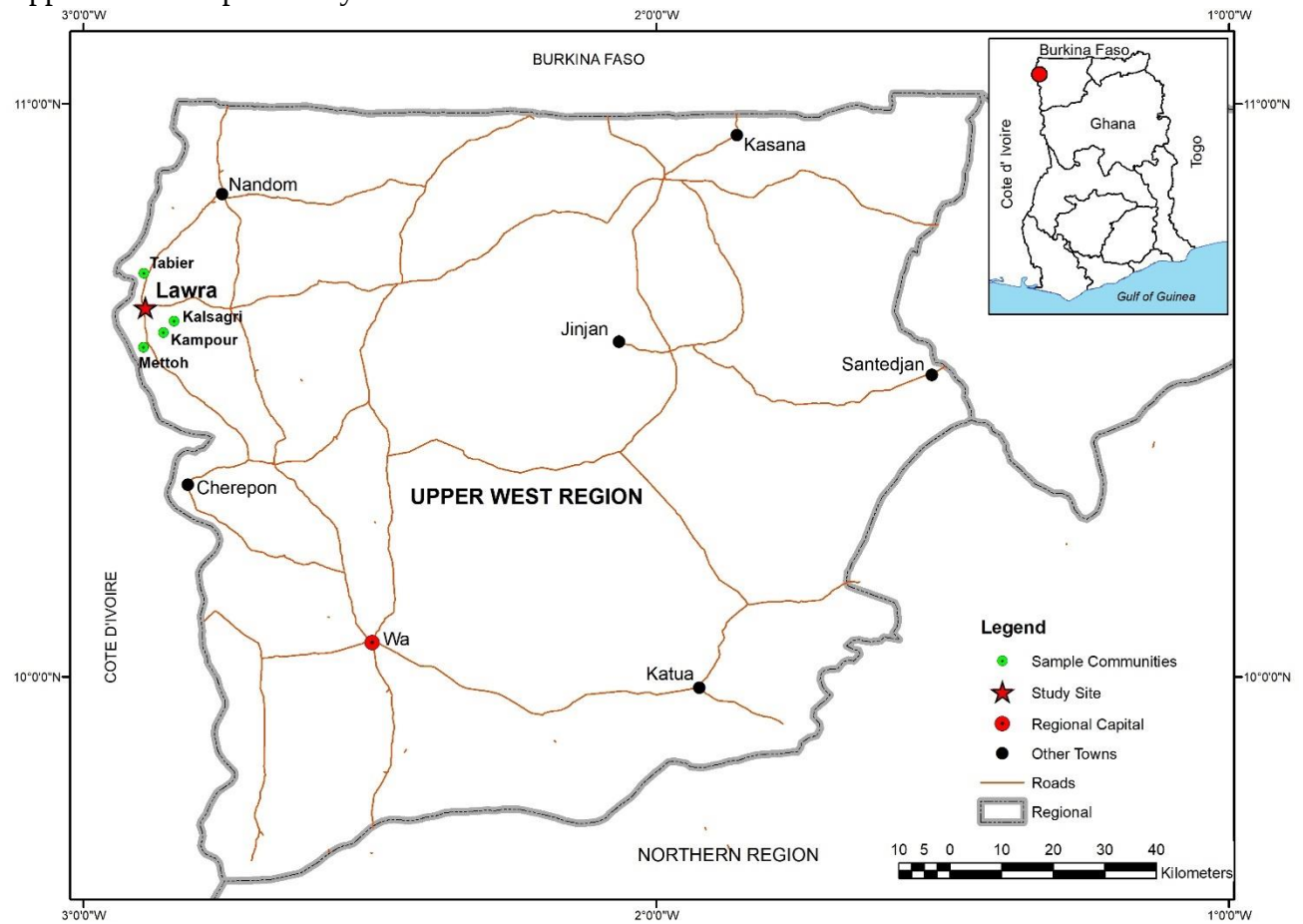
The provision of dams and dugouts and improved access to credit could transform agricultural production and reduce farm households' vulnerability to the adverse impacts of climate change. Stakeholders can engage financial institutions to help local savings organizations to improve access to credit and ensure farmers' financial accountability to lenders. Stakeholder interventions could be directed at improving farm households' access to both tangible and intangible asset

holdings – including small ruminants, information on how to access credit, and links to markets – to improve their adaptive capacity.

These efforts, however, may not yield the expected results because of gender norms and cultural perceptions. Education of all stakeholders can undo these norms and perceptions and improve the adaptive capacity of farmers, particularly female farmers. An inclusive, bottom-up approach between communities and other stakeholders to identify and design future climate change adaptation measures suited to local needs could lead to livelihood transformation, reduce maladaptation, and promote socioeconomic sustainability.

## APPENDICES

## Appendix A: Map of Study Area



## Appendix B: Focus Group Discussion Guide

Gender dimensions of adaptation to climate change among smallholder farmers in rural Ghana:  
A case of Northern Ghana

1. What has been the state of the weather in this community for the past decade (2006-2016). Have there been any changes? What are these changes? How do women (men) explain the causes of these changes in weather? What do you think the weather will be in this area in the future?
2. How has these changes in weather affected agriculture, and livelihood? How have these weather changes affected men in this community? How have these weather changes affected women in this community?
3. How have men's role in the household changed regarding the weather conditions over the past decade? How have women's role in the household changed regarding the weather conditions over the past decade?
3. What have men in this community been doing to reduce negative impacts of the changes on their household and their farm enterprise? What have women in this community been doing to take advantage of the opportunities or to reduce negative impacts of the changes on their household and their farm enterprise? Are there any factors apart from the weather changes that necessitated these changes?
4. What can men and women do differently to survive future changes?
5. What do you consider are the major issues that will prevent you from coping with or adapting to the weather changes?
6. If you were to receive support from government and other relevant stakeholders to adapt to the weather changes in the future, what will you prefer? [Explain the available adaptation options.]
7. What role can the community members play to improve household resilience to the changing weather and the other factors identified earlier? Could you suggest specific roles that community members can play to achieve this?
8. Suggestions and comments on anything that was not captured in the discussion

Appendix C: Household Survey Instrument

UNIQUE ID:

GENDER DIMENSIONS OF ADAPTATION TO CLIMATE CHANGE AMONG  
SMALLHOLDER FARMERS IN RURAL GHANA: A CASE OF NORTHERN GHANA

**RESEARCH INSTRUMENT**

June – August 2017

DEPARTMENT OF COMMUNITY SUSTAINABILITY  
MICHIGAN STATE UNIVERSITY

|                                               |                      |
|-----------------------------------------------|----------------------|
| <b>Community Number</b>                       | <input type="text"/> |
| <b>Household number</b>                       | <input type="text"/> |
| <b>Interviewer</b>                            | <input type="text"/> |
| <b>Completed</b>                              | <input type="text"/> |
| <b>Questionnaire Checked<br/>and approved</b> | <input type="text"/> |
| <b>Date approved<br/>DD/MM/YYYY</b>           |                      |

## CONSENT FORM

Participant Name: \_\_\_\_\_

Interviewer Name: \_\_\_\_\_

Date: \_\_\_\_\_ Time: \_\_\_\_\_

My name is Elsie Assan, a graduate student of Michigan State University. Are you at least 18 years old? *[If not, thank and end interview]*. If yes continue. You are being asked to voluntarily participate in a study about climate change and smallholder farming practices among men and women farmers in Northern Ghana. The findings of this study will help in understanding how men and women farmers have been responding to the changes in the weather in Ghana and help in developing programs that will improve the wellbeing of men and women farmers.

If you agree to take part in this study, I will ask questions about farming and weather changes in this community, how the weather changes have affected your practices and the decisions you have been taken to secure your farm production despite the weather changes. I will also ask you questions about your household, farming and access to agricultural support services in this community. This interview will take approximately 35 minutes of your time.

Your identity and responses to questions will be kept confidential and your privacy will be protected by the maximum extent allowed by law. Reports that will be generated from this process shall be shared using pseudonyms and codes and will not be linked to you. All interviews documents shall be kept in a cabinet in Michigan State University under lock and key. Only researchers will have access to this information.

Your participation is completely voluntary. You may choose not to answer certain questions, and or withdraw from this interview at any time without any consequences to you. It is important for you to know that there are no right or wrong answers.

If you have any questions about this process you may contact the researcher Prof. Murari Suvedi at Michigan State University, 480 Wilson Road, Room 131, East Lansing, MI, 48824. Email: [suvedi@msu.edu](mailto:suvedi@msu.edu). Telephone: +1517 432 0265

If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, Fax 517-432- 4503, or e-mail [irb@msu.edu](mailto:irb@msu.edu) or regular mail at Olds Hall, 408 West Circle Drive #207, MSU, East Lansing, MI 48824.

You indicate your voluntary participation by signing/ thumb printing below.

\_\_\_\_\_  
Signature/Thumbprint

\_\_\_\_\_  
Date

Community name: \_\_\_\_\_ House number of respondent: \_\_\_\_\_

**SECTION A: RESPONDENT IDENTIFICATION**

1. Sex of respondent. **Do not read. Circle appropriate one**

- (1) Male
- (2) Female

2. Where were you born? *Circle only one*

- (1) This village/town (**Skip to Q4**)
- (2) Another village or town in this district
- (3) Another district in this region
- (4) Another region
- (5) Outside of Ghana

3. How long have you lived in this village/town? \_\_\_\_\_

4. What is your age in complete years? \_\_\_\_\_

5. What is your highest level of formal education?

- (1) Some form of basic education (Primary but did not complete JHS)
- (2) Basic education (JHS/ Middle School)
- (2) Secondary School (Secondary/ Vocational)
- (3) Tertiary (Training College/Polytechnic/University)
- (5) None

6. Do you occupy any leadership position in this community? **Circle appropriate answer**

- (1) Yes
- (2) No

7. Are you a member of any religious/social organization in this community?

- (1) Yes
- (2) No

8. If yes, which of the following groups do you belong to?

- (1) Farmer based organization or group
- (2) Village savings and loans group
- (3) Women's group
- (4) Religious group
- (5) Other (*specify*).....

9. Did you participate in community development projects (e.g. clean up exercises, funerals) in the past year?

- (1) Yes
- (2) No

10. How will you describe your household? **Circle only one**

- (1) male headed with one or more wives
- (2) male headed, single, divorced or widowed
- (3) female headed, married but husband away, husband makes most household and farm decisions
- (4) female headed, married but husband away, wife makes most household and farm decisions
- (5) female headed, single, divorced or widowed

11. How many years have you been farming?

12. How many individual farms does your household cultivate?

13. Do you rent, share crop or own these farms? **Circle only one**

- (1) Rent
- (2) Share crop
- (3) Own
- (4) Other .....

14. What is the total size of your farms in acres?

15. What is (are) the source of water for your farming activities?

- (1) Rainfall
- (2) Irrigation
- (3) Both

15a. What is the source of water for your irrigated farm?

- (1) Borehole/well
- (2) Lake/river/stream
- (3) Storage tank or container on the farm
- (4) Other (specify) .....

16. How long does it take you to walk from your house to the farm in minutes/miles?

17. Please tell me if you produce any of these crops I am going to mention to you and whether you produce it mainly for subsistence (household consumption only), for sale/market only, or both and what percentage you sell for the crops you sell.

| S/N | Crop name  | Total produced (bags) | Home use only | For sale only | Both | Number of bags sold |
|-----|------------|-----------------------|---------------|---------------|------|---------------------|
| 1   | Maize      |                       |               |               |      |                     |
| 2   | Rice       |                       |               |               |      |                     |
| 3   | Millet     |                       |               |               |      |                     |
| 4   | Sorghum    |                       |               |               |      |                     |
| 5   | Groundnut  |                       |               |               |      |                     |
| 6   | Cowpea     |                       |               |               |      |                     |
| 7   | Soya beans |                       |               |               |      |                     |

|    |                  |  |  |  |  |  |
|----|------------------|--|--|--|--|--|
| 8  | Okra             |  |  |  |  |  |
| 9  | Tomatoes         |  |  |  |  |  |
| 10 | Pepper           |  |  |  |  |  |
| 11 | Others (specify) |  |  |  |  |  |
| 12 |                  |  |  |  |  |  |

18. Did you use any organic fertilizer/pesticide on any of your crops in the last growing season or ever?

- (1) Yes
- (2) No

18a. If yes, how often do you apply fertilizer/pesticide on your farm?

- (1) Once a year
- (2) Twice a year
- (3) Once every two years
- (4) Other (*specify*).....

18b. If no, please tell me why you did not apply fertilizer/pesticide

.....

.....

.....

.....

19. What is (are) the source (s) of labor for your farming activities in the past year or ever?

- (1) Family labor
- (2) Exchange labor
- (3) Paid or hired labor
- (4) Other (*please specify*)

.....

20. Did your household own any livestock in the past growing season?

- (1) Yes
- (2) No (***Skip to Q21***)

20a. If yes, please, tell me what type and how many does your household own and the purpose for raising them.

| SN | Livestock Type | Total number | Home consumption only | For sale only | Both | Number sold |
|----|----------------|--------------|-----------------------|---------------|------|-------------|
| 1  | Cattle         |              |                       |               |      |             |
| 2  | Pig            |              |                       |               |      |             |
| 3  | Goats          |              |                       |               |      |             |
| 4  | Sheep          |              |                       |               |      |             |
| 5  | Rabbit         |              |                       |               |      |             |
| 6  | Ducks          |              |                       |               |      |             |

|   |                |  |  |  |  |  |
|---|----------------|--|--|--|--|--|
| 7 | Guinea fowl    |  |  |  |  |  |
| 8 | Chicken        |  |  |  |  |  |
| 9 | Other(Specify) |  |  |  |  |  |

## SECTION B: INSTITUTIONAL FACTORS

21. What is the distance from your house to the nearest agricultural input market in kilometers?

22. What is the distance from your house to the nearest market where you sell your produce?

23. Did you borrow money from a bank or lending agency in the last year or ever?

(1) Yes

(2) No (**Skip to 24B**)

24a. If yes which of these lending agencies did you borrow money from? Circle all that apply

(1) Bank eg. Commercial bank

(2) Credit Union

(3) Rural Bank

(4) Other (*specify*) .....

24b. If no, can you please tell me why?

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

.....25. Did you borrow money from any informal sources of credit in the last year or ever?

(1) Yes

(2) No (**Skip to Q 27**)

26. Which of these informal sources did you access credit from?

(1) Relatives

(2) Friends

(3) Village savings and loans group

(4) Money lenders in the community

(5) Other (*specify*) .....

27. Please tell me, on a scale of 1-5, where 1 = Never, 2 = Rarely, 3 = Somewhat frequent, 4 = Frequent, 5 = Very frequent; how frequently you received information from each of the following sources on improving agricultural practices during the growing season in the past year or ever.

| S/N | Source                        | Yes = 1<br>No = 2 | Frequency of receiving info<br>(use code above) |
|-----|-------------------------------|-------------------|-------------------------------------------------|
| 1   | Radio                         |                   |                                                 |
| 2   | Friends                       |                   |                                                 |
| 3   | Agricultural Extension Agents |                   |                                                 |
| 4   | Community announcements       |                   |                                                 |
| 5   | Others in the family          |                   |                                                 |

|          |                     |  |  |
|----------|---------------------|--|--|
| <b>6</b> | NGOs                |  |  |
| <b>7</b> | Neighboring farmers |  |  |
| <b>8</b> | Other               |  |  |

### SECTION C: PERCEIVED CHANGES IN LOCAL CLIMATE

28. How familiar are you with variability in weather in this community?

- (1) Very familiar
- (2) Somewhat familiar
- (3) Not familiar at all

29. Please tell me, on a scale of 1-5, **where 1 = Never, 2= Rarely, 3= Somewhat frequent, 4= Frequent, 5= very frequent**; how frequently you received information from each of the following sources on weather conditions during the growing season in the past year or ever.

| S/N      | Source                           | Yes<br>=1;<br>No =2 | Frequency of<br>receiving info (use<br>code above) |
|----------|----------------------------------|---------------------|----------------------------------------------------|
| <b>1</b> | Radio                            |                     |                                                    |
| <b>2</b> | Friends                          |                     |                                                    |
| <b>3</b> | Agricultural Extension<br>agents |                     |                                                    |
| <b>4</b> | Community<br>announcements       |                     |                                                    |
| <b>5</b> | Others in the family             |                     |                                                    |
| <b>6</b> | NGOs                             |                     |                                                    |
| <b>7</b> | Neighboring farmers              |                     |                                                    |
| <b>8</b> | Other                            |                     |                                                    |

Now, I am going to read some issues in this community to you. Please tell me how concerned you are about this issue and its impact on your farm. [***Please use codes: 1=not concerned 2=less concerned 3=concerned 4=very concerned***]

| ISSUE                                                | 30.How concerned are you about the impact of [ISSUE] on your livelihood?<br><br>[Use codes above] | 31.Did you lose crops due to [ISSUE] in the last growing season?<br><br>Yes =1<br>No=2 | 32. What percentage of crops did you lose to [ISSUE]<br>[write percentage] | 33.Did you lose any livestock to [ISSUE] in the last growing season? | 34. What percentage of livestock was lost to [ISSUE]?<br>[write percentage] |
|------------------------------------------------------|---------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Early onset of rainfall during growing season        |                                                                                                   |                                                                                        |                                                                            |                                                                      |                                                                             |
| Late onset of rainfall during growing season         |                                                                                                   |                                                                                        |                                                                            |                                                                      |                                                                             |
| Rainfall amount growing season                       |                                                                                                   |                                                                                        |                                                                            |                                                                      |                                                                             |
| Unpredictable/Erratic rainfall during growing season |                                                                                                   |                                                                                        |                                                                            |                                                                      |                                                                             |
| Dry spells during growing season                     |                                                                                                   |                                                                                        |                                                                            |                                                                      |                                                                             |
| Drought                                              |                                                                                                   |                                                                                        |                                                                            |                                                                      |                                                                             |
| Excessive heat                                       |                                                                                                   |                                                                                        |                                                                            |                                                                      |                                                                             |
| Bushfires                                            |                                                                                                   |                                                                                        |                                                                            |                                                                      |                                                                             |
| Crop and livestock production Conflicts              |                                                                                                   |                                                                                        |                                                                            |                                                                      |                                                                             |
| Crop and livestock pests and diseases outbreak       |                                                                                                   |                                                                                        |                                                                            |                                                                      |                                                                             |
| Incidence of flood                                   |                                                                                                   |                                                                                        |                                                                            |                                                                      |                                                                             |

|                                                     |  |  |  |  |  |
|-----------------------------------------------------|--|--|--|--|--|
| Emergence of new crop<br>pests and diseases         |  |  |  |  |  |
| Emergence of new<br>livestock pests and<br>diseases |  |  |  |  |  |
| Other (specify)                                     |  |  |  |  |  |
|                                                     |  |  |  |  |  |
|                                                     |  |  |  |  |  |

35. Have you noticed any changes in the local weather in the past decade (2007-2016) especially during the growing season?

- (1) Yes
- (2) No

36. If yes, what change have you noticed?

| SN | Variables                                      | Yes<br>=1,<br>No=2 | Decreased | Stayed<br>same | Increased |
|----|------------------------------------------------|--------------------|-----------|----------------|-----------|
| 1  | Average Temperature                            |                    |           |                |           |
| 2  | Rainfall amount during growing season          |                    |           |                |           |
| 3  | Unpredictable or erratic rainfall              |                    |           |                |           |
| 4  | Early onset of rains during growing season     |                    |           |                |           |
| 5  | Late onset of rains during growing season      |                    |           |                |           |
| 6  | Incidence of flooding                          |                    |           |                |           |
| 7  | Dry spells during growing season               |                    |           |                |           |
| 8  | Duration of rainfall during the growing season |                    |           |                |           |
| 9  | Wind/storms causing crop loss or destruction   |                    |           |                |           |
| 10 | Other<br>.....                                 |                    |           |                |           |

37. What do you think are the reasons for the changes in the weather? *Don't prompt*

- (1) Bushfires
- (2) Deforestation
- (3) Increased farming and livestock rearing
- (4) God's will
- (5) Angry dieties/smaller gods
- (6) Population increase
- (7) Nothing; these are natural changes that happen all the time
- (8) Other (specify).....

#### SECTION D: PERCEIVED IMPACT OF CLIMATE CHANGE ON FARM AND HOUSEHOLD

38. Please tell me on a scale of 1-5, where **1= Not affected, 2=Less affected, 3=somewhat affected, 4=affected, 5=strongly affected** how the changes in weather (especially rainfall and temperature) affected or impacted your livesock and crop production. *Please circle the appropriate answer*

- (1) Not affected
- (2) Less affected
- (3) Somewhat affected
- (4) Affected

(5 ) Strongly affected

39. How did these changes affect your crop and livestock production? **DO NOT PROMPT**

- (1) Less fodder available for livestock
- (2) Less number of livestock
- (3) Loss of backyard gardens/farms
- (4) Decreased crop yields
- (5) Frequent outbreak of crop and livestock diseases/pests
- (6) Low productivity of livestock
- (7) Stopped the cultivation of certain crop/crop varieties
- (8) Reduced/loss of soil fertility
- (9) Other *please specify*.....

40. Please tell me on a scale of 1-5, where **1= Not affected, 2=Less affected, 3=somewhat affected, 4=affected, 5=strongly affected** how the changes in weather (especially rainfall and temperature) affected or impacted your household. ***Please circle the appropriate answer***

- (1) Not affected
- (2) Less affected
- (3) Somewhat affected
- (4) Affected
- (5 ) Strongly affected

41. How did these changes affect your household?

- (1) Scarcity of fuelwood
- (2) Poor health of household
- (3) Shortage in water for drinking and household chores
- (4) Scarcity of food due to reduced yield
- (5) Loss of income due to reduced or total loss of crops
- (6) Reduction in the number of meals eaten in a day
- (7) Other (specify).....

42. Please tell me on a scale of 1-5, where **1= Not affected, 2=Less affected, 3=somewhat affected, 4=affected, 5=strongly affected** how the changes in weather (especially rainfall and temperature) affected or impacted your role as a household head. ***Please circle the appropriate answer***

- (1) Not affected
- (2) Less affected
- (3) Somewhat affected
- (4) Affected
- (5 ) Strongly affected

43. How has the changes you have experienced due to the weather changes affected your role as household head? On a scale of 1-5, with 1 being the highest, please tell me how severe these effects were on your role as household head.

| S/N | Effect of Weather Changes on household head | 1=Yes;<br>No=2 | Rank(1-5; with 1 being highest) |
|-----|---------------------------------------------|----------------|---------------------------------|
| 1   | increased tension and disagreements         |                |                                 |
| 2   | decreased health status                     |                |                                 |
| 3   | pressure to provide food for the family     |                |                                 |
| 4   | reduced quantity of food                    |                |                                 |
| 5   | increased time in searching for fuel wood   |                |                                 |
| 6   | pressure to look for loans                  |                |                                 |
| 7   | increased stress and emotional instability  |                |                                 |
| 8   | decreased quality of food                   |                |                                 |
| 9   | inability to pay for children's basic needs |                |                                 |
| 10  | pressure to sell livestock                  |                |                                 |
| 11  | spend a lot of time searching for water     |                |                                 |
| 12  | others ( <i>specify</i> ).....              |                |                                 |
|     |                                             |                |                                 |
|     |                                             |                |                                 |

## SECTION E: HOUSEHOLD COPING STRATEGIES

44. How did your household cope with the effects of these changes? Please explain

.....

.....

.....

.....

.....

.....

45. Did you receive any external support during this period to help you cope with these changes in your household? (1) Yes

(2) No (*Skip to Q 51*)

46. If yes, who provided this support to you and your household? **Circle all that apply**

(1) Relatives (**Go to 47**)

(2) Other community members (**Go to 48**)

(3) NGO (**Go to 49**)

(4) Government agencies(**Go to 50**)

(5) Other (*specify*).....

47. What kind of support did you receive from relatives?

- (1) Food aid
  - (2) Water
  - (3) Information on crop/Livestock management
  - (4) Soft loan
  - (5) Farm inputs support eg. seeds
  - (6) Healthcare
  - (7) Other specify
- .....

48. What kind of support did you receive from other community members?

- (1) Food aid
  - (2) Water
  - (3) Information on crop/Livestock management
  - (4) Soft loan
  - (5) Farm inputs support eg. seeds
  - (6) Healthcare support
  - (7) Other specify
- .....

49. What kind of support did you receive from NGOs?

- (1) Food aid
  - (2) Water
  - (3) Information on crop/Livestock management
  - (4) Soft loan
  - (5) Farm inputs support eg. seeds
  - (6) Healthcare support
  - (7) Other specify
- .....

50. What kind of support did you receive from Government agencies?

- (1) Food aid
- (2) Water
- (3) Information on crop/Livestock management
- (4) Soft loan
- (5) Farm inputs support eg. seeds
- (6) Healthcare
- (7) Other specify .....

## **SECTION F: FARM AND HOUSEHOLD ADAPTATION PRACTICES IN THE PAST DECADE**

51. Did you engage in any practices in the last decade (When J. A. Kuffour became president till now) because you wanted to protect your farm and household from the harmful effects of the weather?

- (1) Yes
- (2) No (*Skip to 52*)

51a. If yes, please tell me if you implemented any of the following practices and how effective it was in reducing the harmful effects of the weather.

| S/N | Adaptation strategies                                                             | 01=Yes<br>02=No | Not effective | Less effective | Somewhat effective | Effective | Very effective |
|-----|-----------------------------------------------------------------------------------|-----------------|---------------|----------------|--------------------|-----------|----------------|
| 1   | Use of improved varieties                                                         |                 |               |                |                    |           |                |
| 2   | Crop diversification                                                              |                 |               |                |                    |           |                |
| 3   | Soil fertility conservation practices                                             |                 |               |                |                    |           |                |
| 4   | Water and soil moisture conservation practice                                     |                 |               |                |                    |           |                |
| 5   | Changing planting and harvesting dates                                            |                 |               |                |                    |           |                |
| 6   | Planting of trees or fruit trees                                                  |                 |               |                |                    |           |                |
| 7   | Selling assets                                                                    |                 |               |                |                    |           |                |
| 8   | Diversify into non-farm activities e.g pito brewing, shea nut processing, trading |                 |               |                |                    |           |                |
| 9   | Dry season gardening                                                              |                 |               |                |                    |           |                |
| 10  | Use of irrigation                                                                 |                 |               |                |                    |           |                |
| 11  | Migrate to look for jobs                                                          |                 |               |                |                    |           |                |
| 12  | Use my savings to support family/farming activities.                              |                 |               |                |                    |           |                |

58. Please tell me three reasons or issues that prevented you from adapting to climate change in the past decade?

- 1.....
- 2.....
- 3.....

53. Please tell me which of these additional measures will you prefer or consider in securing your farming activities and household wellbeing under rainfall and temperature changes during crop growing season in the future. **On a scale of 1-5, where 1= Not relevant, 2=less relevant, 3=somewhat relevant, 4=relevant 5=very relevant** please rank the selected measure.

| S/N | Adaptation measures                        | Yes = 1, No = 2 | Rank (Use codes above) |
|-----|--------------------------------------------|-----------------|------------------------|
| 1   | Community irrigation facility              |                 |                        |
| 2   | Reserved trees for charcoal production     |                 |                        |
| 3   | Personally sink wells or boreholes         |                 |                        |
| 4   | Drought tolerant crops or seeds            |                 |                        |
| 5   | Post-harvest processing/storage technology |                 |                        |
| 6   | Seasonal weather forecast                  |                 |                        |
| 7   | Crop insurance                             |                 |                        |
| 8   | Training in alternative livelihood options |                 |                        |
| 9   | Planting trees for shade on farm           |                 |                        |
| 10  | Look for off-farm employment               |                 |                        |
| 11  | Other ( <i>specify</i> )                   |                 |                        |

#### SECTION G: PREFERRED ADAPTATION UNDER RAINFALL UNCERTAINTY AND HEATSTRESS

54. Now I will read some institutional strategies which might help you to adapt to weather changes (especially rainfall and temperature changes) in the future? Please tell me which support you **not at all prefer, less prefer, and most prefer** in adapting to the changes in the weather condition and who should provide the support.

| S/N | Adaptation support                                                                                                                      | Not at all prefer | A little prefer | Most prefer |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------|-------------|
| 1   | Improved access to credit                                                                                                               |                   |                 |             |
|     | Improved farmer-researcher linkage in agricultural research                                                                             |                   |                 |             |
| 6   | Provision of seasonal forecast/community weather monitoring station                                                                     |                   |                 |             |
|     | Improvement in access and ownership to land                                                                                             |                   |                 |             |
| 7   | Provision of post-harvest technology such as food processing, packaging, etc. and improved access to regional and international markets |                   |                 |             |
| 8   | Introduction of grants/price support to farmers to cover crop and livestock loss                                                        |                   |                 |             |
| 13  | Farmer adaptation capacity building through extension education and training                                                            |                   |                 |             |
| 14  | Dam or dug outs for irrigation                                                                                                          |                   |                 |             |
| 17  | Grain bank or storage facility                                                                                                          |                   |                 |             |

55. Which of the following sources will you prefer to receive the support for future adaptation to weather changes from? **Circle all that apply**

- (1) Central Government/Research Institutions
- (2) Local Government
- (3) Non-Governmental Organizations
- (4) Traditional leaders
- (5) Community self help groups
- (6) Fellow farmers
- (7) Other

(specify).....

56. How likely are you to participate in local weather monitoring (e.g wind, rainfall, temperature) at a community weather station in the future?

- (1) Not likely
- (2) Less likely
- (3) Neutral
- (4) Likely
- (5) Very Likely

## SECTION H: HOUSEHOLD CHARACTERISTICS

57. What is the total number of people living in your household? .....

58. What is the main source of income of your household in the past 12 months? *Circle one*

- (1) Crop and Livestock production
- (2) Trading
- (3) Artisan/Craftsman/Vocational
- (4) Civil/ Public servant
- (5) Remittance
- (6) Other (specify) .....

59. Please tell me, if you earned income from any of these sources and how many Ghana Cedis on the average was earned from each (**SOURCE**) in the past year?

| Source                                                                | Ghana Cedis (GHc) |
|-----------------------------------------------------------------------|-------------------|
| Crop production (eg. maize, vegetables, sorghum, etc.)                |                   |
| Paid employment (Public/civil servant job)                            |                   |
| Non-farm activity                                                     |                   |
| Livestock rearing and animal products                                 |                   |
| Hunting and gathering                                                 |                   |
| Trading of non-agricultural products (crafts, artisan, clothes, etc.) |                   |
| Remittance                                                            |                   |
| Pension                                                               |                   |
| Another source (specify)                                              |                   |
|                                                                       |                   |
|                                                                       |                   |

60. What is the main source of drinking water for your household during the rainy season?

- (1) Pipe-borne inside/outside house
- (3) River/stream
- (4) Rainwater
- (5) Bore hole/well
- (6) Dugout/pond
- (7) Other (specify).....

61. What is the main source of drinking water for your household during the dry season? Circle only one

- (1) Pipe-borne inside/outside the house
- (3) River/stream
- (4) Rainwater
- (5) Bore hole/well
- (6) Dugout/pond
- (7) Other (specify).....

62. What is the main source of energy for lighting in your household? Circle only one

- (1) National grid
- (2) Generator
- (3) Car battery
- (4) Solar battery
- (5) Kerosene
- (6) Dry cell
- (7) other (specify) .....

63. What is the main source of energy for your household? Circle only one

- (1) Charcoal
- (2) Fuelwood
- (3) Cow dung
- (4) Gas
- (5) Kerosene
- (6) Other (specify).....

64. Does your household own the house in which you live?

- (1) Yes
- (2) No

65. How many rooms (including kitchen and bath) are in your house?

66. What material is the outer wall of your house made of?

- (1) Cement/concrete
- (2) Mud/mud bricks
- (3) Cow dung
- (5) Coal tar mixed with mud
- (4) Other (Specify).....

67. What material is the roof of your house made of?

- (1) Raffia thatch/grass
- (2) Wood
- (3) Corrugated iron sheets
- (4) Mud bricks
- (5) Slate
- (6) Roofing tiles
- (7) Concrete/cement
- (8) Other (specify) .....

68. Now, I am going to read a list of assets to you. Please tell me if your household owns any of these, how many you own and how much you will gain if you sold these assets.

| S/N | Asset                    | Yes =1; No = 2 | Quantity owned |  |
|-----|--------------------------|----------------|----------------|--|
| 1   | Car                      |                |                |  |
| 2   | Motorcycle               |                |                |  |
| 3   | Bicycle                  |                |                |  |
| 4   | Sewing machine           |                |                |  |
| 5   | Generator                |                |                |  |
| 6   | Tractor                  |                |                |  |
| 7   | Hoe                      |                |                |  |
| 8   | Matchete                 |                |                |  |
| 9   | Wheelbarrow              |                |                |  |
| 10  | Plough                   |                |                |  |
| 11  | Knapsack Sprayer         |                |                |  |
| 12  | Mobile phone             |                |                |  |
| 13  | Radio                    |                |                |  |
| 14  | Television               |                |                |  |
| 15  | Savings account          |                |                |  |
|     | Other ( <i>specify</i> ) |                |                |  |
| 16  |                          |                |                |  |
| 17  |                          |                |                |  |

Interview end time:

**(END INTERVIEW)**

**THANK YOU VERY MUCH FOR TAKING TIME TO PARTICIPATE IN THIS STUDY.**

## Appendix D: Key Informants Interview Guide

| Required Information                                                                                                        | General Question                                                                                                                                                            | Possible Guiding Questions                                                                                                                                                                                                 | Interviewees                                                      |
|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| Changes in the climate of the community in the past decade (2006-2016)                                                      | Are there any past and present changes in the climate in the community and how are these changes explained by community members?                                            | Have there been any changes in the climate variables specifically rainfall and temperature for the past decade?                                                                                                            | AEAs, NGO representatives, Women's group leaders, Village leaders |
|                                                                                                                             |                                                                                                                                                                             | What are the reasons/causes for these changes?                                                                                                                                                                             | AEAs, NGO representatives, Women's group leaders, Village leaders |
| Impact of these changes on male and female heads of household.                                                              | How have the livelihoods of male and female headed households been affected by these changes over the period?                                                               | How have male and female heads of households' role been affected by these changes? Which of these group have been most affected by these changes? Why do you think so?                                                     | AEAs, NGO representatives, Women's group leaders, Village leaders |
| Coping and adaptation strategies employed by male and female heads of household to secure their farm livelihood and family. | Are there any changes in farming practices or livelihoods that are being or have been implemented by male and female heads of households?<br>Are these changes sustainable? | Have male and female heads of households made changes in their agricultural practices in response to climate change over the last decade?<br>Have they stopped growing some particular crops as a result of these changes? | AEAs, NGO representatives, Women's group leaders, Village leaders |
|                                                                                                                             |                                                                                                                                                                             | Are there any other factors or situations that may have necessitated these changes in ?                                                                                                                                    | AEAs, NGO representatives, Women's group leaders, Village leaders |
|                                                                                                                             |                                                                                                                                                                             | How do male and female heads of households differ in their choice of farm practices or adaptation measures in response to the climate changes?                                                                             | AEAs, NGO representatives, Women's group leaders, Village leaders |
|                                                                                                                             |                                                                                                                                                                             | Does access to extension, credit, markets and other critical resources                                                                                                                                                     | AEAs, NGO representatives, Women's group leaders, Village leaders |

|                                                                                                                |                                                                                                                                       |                                                                                                                                            |                                                                   |
|----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
|                                                                                                                |                                                                                                                                       | influence choice of adaptation strategies by men and women farmers?                                                                        |                                                                   |
|                                                                                                                |                                                                                                                                       | Could timely availability of climate forecasts and agricultural information have contributed to changes in the farming practices?          | AEAs, NGO representatives, Women's group leaders, Village leaders |
| Barriers to effective adaptation                                                                               | What are the constraints that male and female heads of household face in adapting to the changes in climate?                          | Are there constraints to effective adaptation among?<br>What are some of these constraints?                                                | AEAs, NGO representatives, Women's rep, Village leaders           |
|                                                                                                                |                                                                                                                                       | What has led to these constraints?                                                                                                         | AEAs, NGO representatives, Women's rep, Village leaders           |
| Institutional support for future adaptation to climate change taking into consideration gender-specific needs. | In what ways can male and female heads of household be supported by government and relevant stakeholders to adjust to climate change? | What can you suggest as relevant interventions to help male and female heads of household to successfully adapt to the changes in climate? | AEAs, NGO representatives, Women's rep, Village leaders           |

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## CHAPTER FOUR

### SUMMARY AND CONCLUSIONS

The adverse impacts of climate change could worsen vulnerabilities among households who are dependent on climate-sensitive livelihood activities. Therefore, policy and intervention programs could be designed and implemented to improve the adaptive capacity of farm households and enhance sustainability in a changing climate. This could be achieved by incorporating the perspectives and needs of different farm households in the planning process to prevent maladaptation. However, little is known about the gender dimensions of climate change perceptions, adaptation and coping response to adverse climate change impacts, and preferred institutional support for adaptation at the household level in northwestern Ghana.

Using empirical data from the Lawra district in northwestern Ghana, this study explored farmers' perspectives on climate change and its impact on their farming activities and household well-being. The study also assessed the climate change coping and adaptation measures adopted by male and female heads of farm household to reduce vulnerability to adverse impacts of climate change, and examined the perceptions of farm household heads on the effectiveness of current climate change adaptation practices, and their preference for institutional support for adapting to climate change impacts.

A mixed-methods approach comprising key informant interviews, household surveys, and focus group discussions were adopted for data collection. Purposive sampling was used to select participants for the key informant interviews and focus group discussions, while convenience sampling was adopted for the selection of participants for the household surveys. While stratified random sampling could have been a better alternative in sampling participants for the household surveys, the sampling technique could not be employed since the farmers were busily engaged in

land preparation and planting activities at the time of the study and were not easily accessible. Nonetheless, the findings of the study have relevance for institutional intervention in climate change adaptation planning in Ghana and other countries.

The key study findings are:

- There were no differences in climate perceptions between male and female heads of farm households.
- Climate change impacts on farming and livelihoods are mainly exacerbated by anthropogenic activities such as bush burning and deforestation.
- Male heads of farm households are more concerned about the effects of climatic stressors on their livelihoods; female heads of farm households are particularly concerned about the effects of non-climatic stressors on their livelihoods and household well-being.
- Both male and female heads of farm households experience yield and income losses due to climate change impacts.
- Cultural norms and perceptions increase female farmers' vulnerability to climate impacts.
- Lack of money, lack of labor, inadequate extension services, lack of information on local climate, and lack of access to adaptation strategies are major constraints in reducing climate change impacts.
- Male and female heads of farm households mainly engage in borrowing from village savings and loans group, sale of forest products, sale of livestock, and temporary migration as coping measures to reduce the impact of climatic shocks on their livelihood activities.
- More male heads than female heads of farm households engage in climate change adaptation practices.

- Current adaptation practices were perceived by both male and female heads of farm households as effective in reducing the effects of adverse climate change impacts on their livelihoods and household well-being.
- Dams, dug outs, and improved access to credit were the most preferred types of potential institutional adaptation support for both male and female heads of households.
- External agencies (NGOs and government agencies) were the most preferred source of institutional support for climate change adaptation.

Incorporating gender perspectives of climatic stressors into climate change adaptation intervention planning and development could help improve the socioeconomic well-being of vulnerable farm households. Gender norms and cultural perceptions have the potential to undermine the productive capacity of female farmers. Education of all stakeholders can undo these norms and perceptions to improve household food security and well-being and increase the resilience of female farmers to adverse effects of climatic stressors. Additionally, education on sustainable management of forest resources could minimize vegetation depletion, contribute to climate change mitigation, and reduce the adverse impacts of climatic stressors on farm households. Engagement of agricultural extension agents, forestry officers, and community members in sustainable use of forest resources and reforestation could enhance food security and income generation among households. Further, less labor-intensive adaptation practices could improve the resilience of farmers to adapt to climate change impacts.

The provision of dams and dugouts and improved access to credit could transform agricultural production and reduce farm households' vulnerability to the adverse impacts of climate change. Stakeholders can engage financial institutions to help local savings organizations to improve access to credit and ensure farmers' financial accountability to lenders. Stakeholder interventions

could be directed at improving farm households' access to both tangible and intangible asset holdings, including small ruminants, information on how to access credit, and links to markets, to improve their adaptive capacity. An inclusive, bottom-up approach between communities and other stakeholders to identify and design future climate change adaptation measures suited to local needs could lead to livelihood transformation, reduce maladaptation, and promote socioeconomic sustainability.