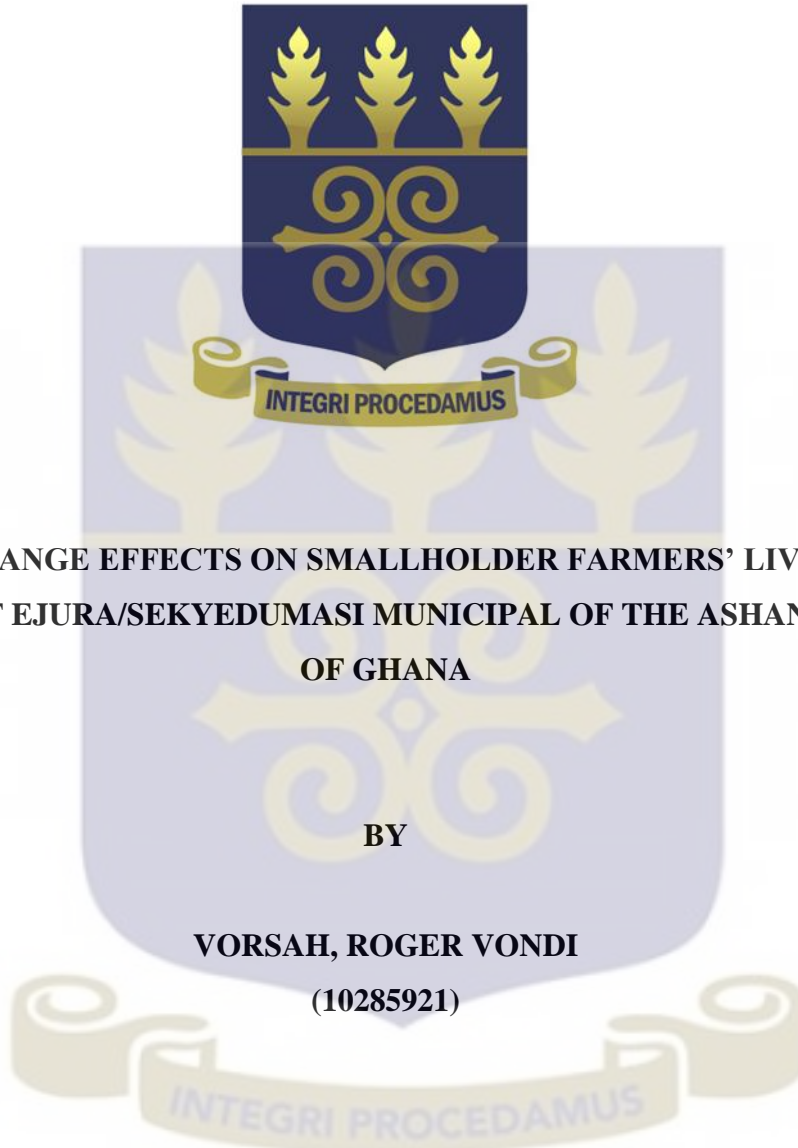


**UNIVERSITY OF GHANA**



**CLIMATE CHANGE EFFECTS ON SMALLHOLDER FARMERS' LIVELIHOODS:  
THE CASE OF EJURA/SEKYEDUMASI MUNICIPAL OF THE ASHANTI REGION  
OF GHANA**

**BY**

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(10285921)**

**THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN  
PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF  
MASTER OF PHILOSOPHY DEGREE IN CLIMATE CHANGE AND  
SUSTAINABLE DEVELOPMENT**

**JULY 2015**

**DECLARATION**

I, Roger Vondi Vorsah, the author of this thesis titled “**CLIMATE CHANGE EFFECT ON SMALLHOLDER FARMERS’ LIVELIHOODS: THE CASE OF EJURA/SEKYEDUMASI MUNICIPAL OF THE ASHANTI REGION OF GHANA**”, hereby declare that, this work was done entirely by me at the School of Social Science, University of Ghana, Legon from August 2014 to July 2015.

This work has never been presented either in whole or in part for any other degree at this University or elsewhere, except for the past and present literature, which have been duly cited.

..... Date.....

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(STUDENT)

This thesis has been presented for examination with our approval as supervisors

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DR. CHARLOTTE WRIGLEY-ASANTE  
(PRINCIPAL SUPERVISOR)

.....  
DR. KWADWO OWUSU  
(CO-SUPERVISOR)

## **DEDICATION**

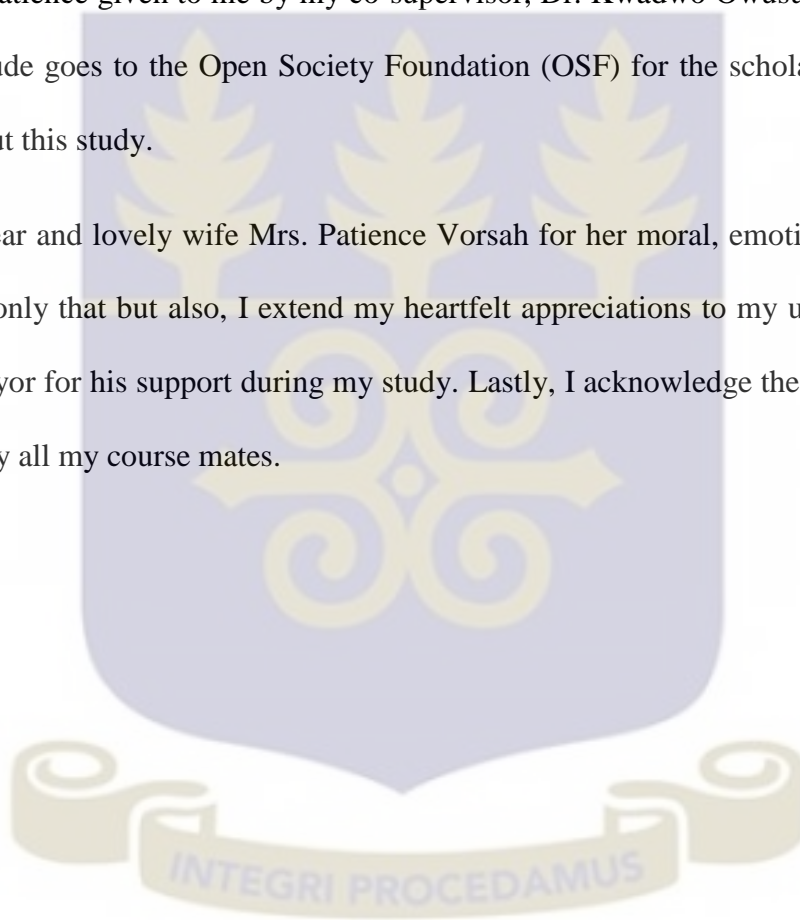
I dedicate this work to the almighty God, my parents and siblings and dearest wife (Mrs Patience Vorsah) whose prayers and guidance have brought me this far today. May the good Lord richly bless you all.



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Firstly, I am most grateful to the Almighty God for His grace and protections for me throughout this study. I wholeheartedly thank my principal supervisor, Dr. Charlotte Wrigley-Asante who despite her busy schedules gave me immeasurable guidance and constructive criticisms that went a long way to improve my work. Also, I appreciate the invaluable support and greatest patience given to me by my co-supervisor, Dr. Kwadwo Owusu. In addition, my sincere gratitude goes to the Open Society Foundation (OSF) for the scholarship awarded to me to carry out this study.

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## ABSTRACT

Climate change is causing unusual, unpredictable and extreme weather events in the Ejura/Sekyedumasi Municipal. Although this level of exposure to climate change affects everyone in the Municipality, its impacts are differently distributed between men and women. The main objective of this study was to analyse the effects of climate change on the livelihoods of both men and women smallholder farmers. The study employed both primary and secondary data. Multistage sampling techniques were used to select the respondents. The DFID and Oxfam Livelihood Approaches guided the analyses. The study identified that both men and women smallholder farmers' perceived climate change as serious threat to their livelihoods with more women being adversely affected. Reasons were attributed to the gender roles that exist in the Municipality. In contrast, the Phi correlation test showed a positive and significant relationship between climate change and women's livelihoods. This implies that climate change impacts positively impact on women's livelihoods while it adversely affect the men's. In the face of climate change, men and women smallholder farmers adopt coping strategies to safeguard their livelihoods. Majority of the women adopted on-farm coping strategies such as diversification of crops or changing planting/harvesting dates. Most men adopted off-farm and non-farm coping strategies such as working as labourers on other farms or migrate to the cities for better income opportunities. The study recommends that, climate change awareness programmes should target both sexes, in order to build their capacity to cope with the stresses and uncertainties of local livelihoods. Also, since the impacts affect the most vulnerable in the society of which women are the majority, it is necessary to include their voices, needs, and expertise in climate change debate, policy and programming so as to design appropriate measures to help address the challenges.

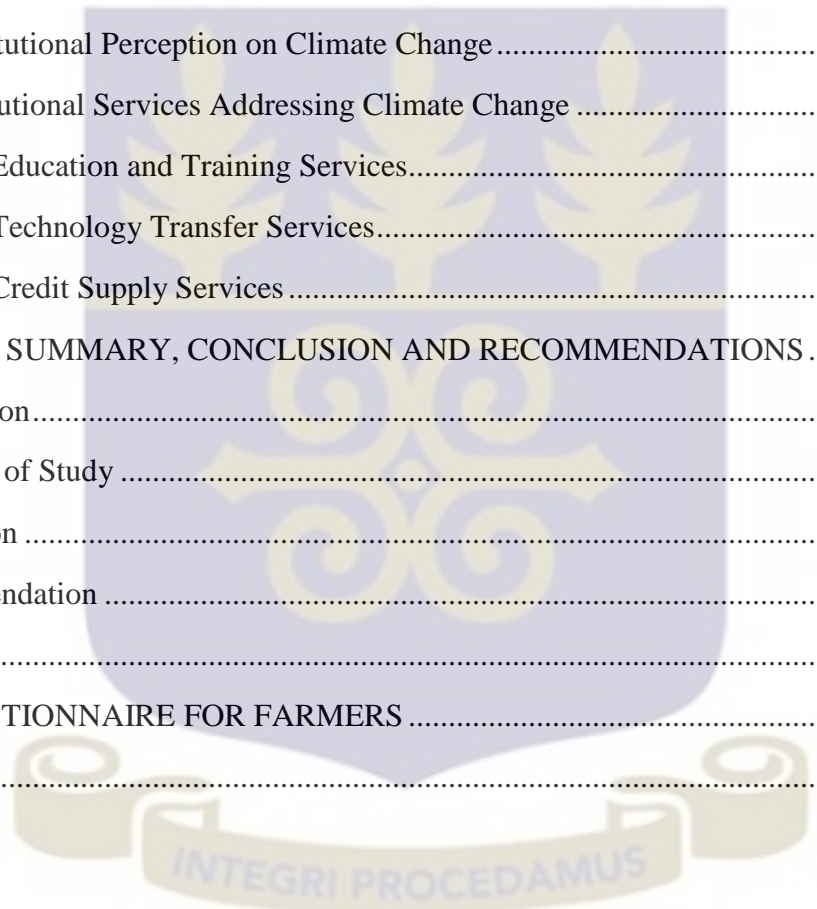
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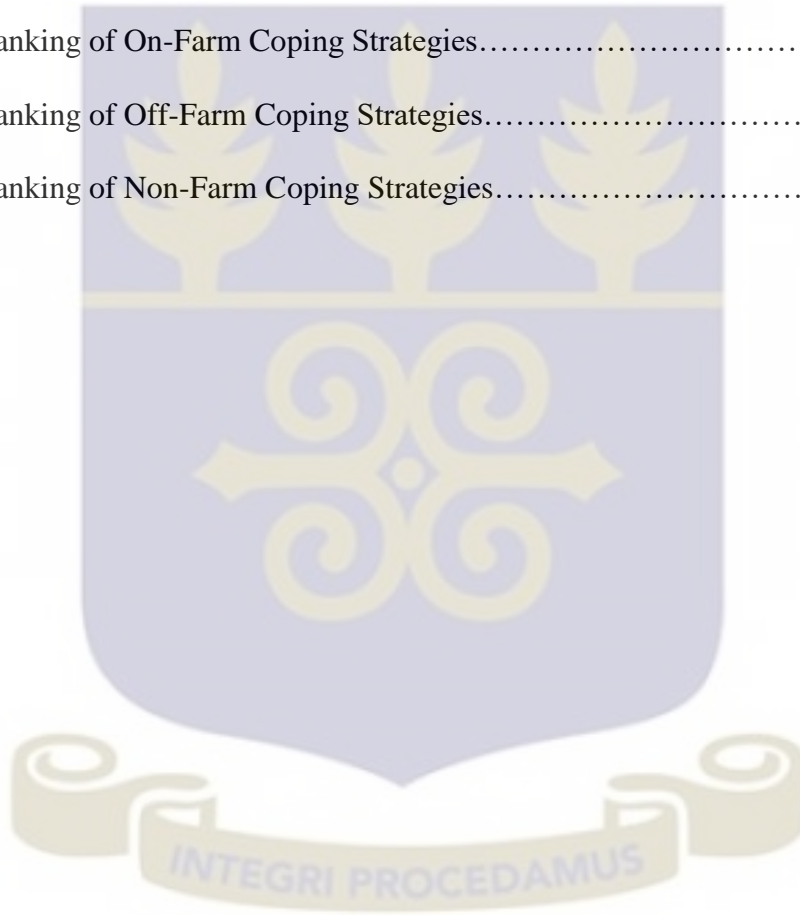


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## LIST OF ABBREVIATIONS

CARE	Cooperative for Assistance and Relief Everywhere
CBOs	Community-Based Organizations
CEEPA	Centre for Environmental Economics and Policy in Africa
COCOBOD	Ghana Cocoa Board
DFID	Department for International Development
EPA	Environmental Protection Agency
FAO	Food and Agricultural Organization
FC	Forestry Commission
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GSS	Ghana Statistical Service
IPCC	Intergovernmental Panel on Climate Change
ISSER	Institute of Statistical, Social and Economic Research
MEST	Ministry of Environment, Science and Technology
MFCS	Multi-Features and Capacity-Enhancing Services
MLGRD	Ministry of Local Government and Rural Development
MoFA	Ministry of Food and Agriculture
NGOs	Non-Governmental Organizations
OXFAM	Oxford Committee for Famine Relief
SLF	Sustainable Livelihood Framework
UNFCCC	United Nation Framework Convention on Climate Change
UNDP	United Nation Development Program

UNICEF	United Nation International Children’s Emergency Fund
USAID	United States Agency for International Development
WHO	World Health Organization
WVI	World Vision International



## CHAPTER ONE

### INTRODUCTION

#### 1.0 Background

Climate change has become one of the most pressing issues on the developmental agenda. While mankind has always had to live with, deal with and adapt to environmental challenges, the challenges posed by climatic change are however believed to be of such a magnitude as to exceed historical experiences. This is likely to result in unprecedented challenge to local communities and the global community at large (Christoplos *et al.*, 2009; Schipper, 2007). With the fourth Intergovernmental Panel on Climate Change (IPCC) report cementing the linkage between anthropogenic activities and climate change, much of the climate change debate and research has focused on the issue of climate change mitigation and adaptation (IPCC, 2007). Yet as the report discloses, mitigation efforts aiming at reducing emissions will not suffice and adaptation will be necessary as the impacts of warming linked to past emissions would be unavoidable (Christoplos *et al.*, 2009; Heltberg *et al.*, 2008; IPCC, 2007).

The concept of livelihood on the other hand has been extensively explained by the Department for International Development (DFID) of the United Kingdom and other institutions as well as individual researchers and development practitioners. Livelihood as observed by Carney (1999) comprises the capabilities and assets required for of living. The Sustainable Livelihoods Framework (SLF), which was developed by the DFID (2000) defined livelihood as gains made by individuals or households and various factors that affect the level, maintenance and enhancement of these gains. Akudugu (2011) defines livelihoods as the ability of individuals and households to take care of health, educational, food, social and cultural needs and to make

savings for future use. Therefore a livelihood is sustainable when it can cope and recover from stresses and shocks and maintain or enhance its capability and assets, while not undermining the natural resource base (Chambers & Conway, 1992). Individuals, households and communities engage in a number of activities and strategies in order to earn a living. Prominent among these livelihood activities and strategies in developing countries is farming which incidentally is the worst affected by climate change (IPCC, 2001).

The global South, notably the African continent, is perceived as particularly vulnerable to climate change impacts due to its nearness to the equator as well as high poverty levels and low adaptive capacity (Pidwirny, 2006 and IPCC, 2007). As anticipated rise in temperatures would greatly affect regions where temperatures are already high, leading to high evaporation losses that would impact on sectors like agriculture (IPCC, 2007 and Mertz *et al.* 2009). Climate change would not only elicit a variety of direct climatic changes, but the impacts of these may furthermore trigger a range of other indirect effects and elicit new risks (Mertz *et al.*, 2009). Warmer temperatures or a more humid climate may alter local disease patterns, or alterations in terms of agricultural production that might impact adversely on the livelihoods of smallholder farmers and increase their poverty levels (Christoplos *et al.*, 2009; Heltberg *et al.*, 2008). Seeing that many developing countries, in Africa, rely heavily on climate sensitive activities such as agriculture, for livelihood and income at both the national and local levels, climate change is likely to significantly affect national economies and local livelihoods. Furthermore, these countries are moreover further at risk due to having limited financial and technical capacity to deal with and adapt to expected changes, as well as are already being confronted with a range of challenges, both climate related and non-climatic stressors such as conflicts and wars; economic crisis and high population growth (Heltberg *et al.*, 2008; IPCC, 1998; Mertz *et al.*, 2009).

The semi-arid region of Africa is an area already characterized by climatic variability on both inter-annual and multi-decadal scales and prone to droughts, represents one region that is particularly vulnerable to climate change (Nassef *et al.*, 2009). The smallholder farmers' population in West Africa mostly in arid and semi-arid regions whose livelihoods circle around crop production and livestock rearing are thus perceived to be significantly at risk as climate change would impact on the availability of water, vegetation growth and critical inputs for agricultural production (Nori *et al.*, 2008). Having been hit by a series of repeated droughts in the first decade of the 21st century, which had led to widespread impoverishment, loss of livelihood and food insecurity concerns have been raised regarding the future sustainability of the agricultural sector. Especially given the looming challenge of climate change, which would compound current issues of livelihood vulnerability and poverty (Ashley & Carney, 1999; Nassef *et al.*, 2009; Neefjes, 2000).

Ghana relies heavily on climate sensitive sectors such as agriculture and forestry partly for rural livelihoods and the growth of its economy. According to ISSER (2013), agriculture continues to be the main contributor to the economy of Ghana. For instance, in the year 2012, agriculture contributed 22.7 per cent to the GDP and it was the biggest source of foreign exchange, accounting for about 40 per cent of Ghana's foreign currency earnings; and the main producer of two-thirds of the domestic food need (ISSER, 2013). In addition, about 70 per cent of the manufacturing value-added is based on agricultural raw materials, and it also employs about 56 per cent of the workforce with about 80 per cent being in the rural areas with small landholdings less than 2 hectares (GSS, 2008; FAOSTAT, 2010).

However, despite all the importance agriculture offers to the Ghanaian economy, the sector is bedevilled by the adverse impacts of climate change and extreme weather events (Akudugu,

2012) and this was highlighted in the Ghana's Second Communication to the UNFCCC (MESTI, 2011). According to the second communication, climate change has increased pressure on water resources thereby endangering farming activities; reduced yield leading to poverty and food security crisis as well as loss of smallholder farmers' livelihood a situation that has resulted in a decline in national revenue (MESTI, 2011). Furthermore, a survey conducted by the Ghana Statistical Survey (GSS) and other researchers revealed that, high poverty levels in rural areas of Ghana that resulted in loss of livelihoods can be emphatically attributed to climate change and extreme weather events in addition to non-climatic stressors such as civil strife and economic crisis (GSS, 2008; Hesselberg & Yaro, 2006; Akudugu, 2012).

### **1.1 Problem Statement**

Weather related events such as erratic rainfall; longer drought periods and floods are increasing in terms of both magnitude as well as frequency in Ghana (FAO, 2008). Such events have been creating natural hazards and adversely impacting on smallholder farmers' livelihoods (Yaro, 2002; Hesselberg & Yaro, 2006; Akudugu, 2012). The negative consequences of natural hazards hamper the livelihoods of the rural poor who heavily depend on climate sensitive sectors. According to Bartlett (2008) and Rohr (2007) the impacts of natural hazards such as climate change have differential effects on the lives and livelihoods of both men and women and this UNDP (2007) attributed to the roles society places on men and women.

Several studies on gender and climate change have confirmed this assertion (Aquilar, 2004; WEDO, 2008; Chowdhury *et al.*, 1993; Skutch, 2004; Neumayer & Plumper, 2007; Pruss-Ustun *et al.*, 2008). According to Aquilar (2004), about 90 per cent of flood-related fatalities in Bangladesh in 1991 were women and children and this was primarily attributed to the reproductive role as well as movement restrictions assigned to them by society. Pruss-Ustun *et*

*al.* (2008) also concluded that in period of drought and water scarcity, due to socially constructed roles, women have no choice but to carry heavy water containers for longer distance and sometimes from unsafe sources, which incidentally adversely affected their health and reduce the time needed for them to take part in other productive activities. In a study conducted by FAO, it was revealed that, more women are likely to lose their livelihoods to climate change and extreme weather variability as compared to their male counterparts due to the latter's lack of resources which was brought upon them by society (FAO, 2001).

A study conducted by Fosu-Mensah *et al.* (2012) and USAID and MFCS (2014) it was revealed that the semi-deciduous and transitional zone of Ghana experience climatic changes and extreme weather variations among which increase in temperature and decrease in rainfall are the major climate change challenges that are being experienced by farmers who mostly cultivate food crops primarily for household consumption. Their study among others such as Sagoe (2006) and Codjoe and Owusu (2011) was limited to examining the evidence of climate change, climate change impacts on agriculture as well as analyzing farmers' adaptation responses to the changing climate. These studies confirm the assertion of the IPCC that climate research has focused largely on predicting the impacts on agriculture and economic activities with less effort being focused on understanding the differential impact of climate change on the livelihood of individuals and households (IPCC, 2001). The same report also indicates that there is now global confidence in predictions of climate change at global level but there is still great uncertainty at the regional, local and household levels, where information is required by both male and female, who experience climate change differently, to reduce the impact on their livelihoods.

The problem haunting the smallholder farmers in the Ejura/Sekyedumasi municipal of the Ashanti region lies in the changing climate that is adversely affecting economic activities

(MLGRD, 2006). According to MLGRD (2006), agricultural activities are highly segregated in the Municipality such that majority of the women are into food crop production with limited landholdings and inadequate resources while the male farmers are into cash crop production with relatively larger lands and adequate resources. This inequality has marginalized the women farmers in the Municipality (MLGRD, 2006) and this is likely to exacerbate climate change impacts on their attainment of livelihoods. This research seeks to investigate the differential impacts of climate change on male and female smallholder farmers and the coping strategies employed by different gender groups in adapting to the impacts of climate change.

From the foregoing the following research questions become pertinent:

To what extent are smallholder farmers concerned about changing climate?

How have recent changes in climate and weather conditions influenced the livelihoods of both men and women smallholder farmers?

In the face of climate change, what are the coping strategies employed by men and women smallholder farmers in the Municipality to safeguard their livelihoods?

What are the measures put in place by institutions to assist smallholder farmers address climate change challenges?

## **1.2 Objective of the Study**

The main objective of the study was to assess the effect of climate change on the livelihoods of smallholder farmers in the Ejura/Sekyedumasi Municipality of the Ashanti Region of Ghana.

The specific objectives include:

1. To describe the perception of smallholder farmers on climate change in the Ejura/Sekyedumasi Municipality.

2. To determine the effects of climate change on the livelihoods of both men and women smallholder farmers in the Municipality.
3. To determine and rank the coping strategies that were employed by male and female smallholder farmers in the face of climatic change challenges.
4. To identify the role of institutions in addressing smallholder farmers' adaptation to climate change in the Municipality.

### **1.3 Relevance of the Study**

One of the several reasons for social science research is to provide empirical support for understanding human behavior. Therefore probing into the effect of climate change on the livelihoods of smallholder farmers in the Ejura-Sekyedumasi would help in improving the level of understanding of smallholder farmers' behavior based on observed evidence.

According to IPCC (2001) climate change is more and more recognized as a global concern and likely to exacerbate unfavorable conditions including gender related inequalities. The same report argues that climate research has focused largely on predicting the impacts on agriculture and economic activities with less effort being focused on understanding the differential impact of climate change on gendered livelihoods. Available data suggests high level of gender inequalities in Ghana, especially in the agricultural sector (MLGRD, 2006; MOFA, 2008; MOWAC, 2012) as well as an increasing frequency and severity of weather related hazards (IPCC, 2007; Fosu-Mensah *et al.*, 2012; MESTI, 2011). Therefore, the findings of this study would better inform relevant stakeholders in the agricultural sectors about the differential effects climate change is having on the livelihoods of both men and women in the sector so as to design the appropriate measures, taking into consideration the gendered nature of the impacts, that would help address this challenges in the Municipality and the country as a whole.

According to Agrawal (2008), not only have existing institutions affected how rural residents responded to environmental challenges in the past, they are also the fundamental mediating mechanisms that would translate the impact of external interventions to facilitate adaptation to climate change. Also institution structure risks and sensitivity to climate hazards, facilitate or impede individual and collective responses, and shape the outcomes of such responses (Agrawal, 2008). Therefore understanding how they function in relation to climate change and its impact is a core component in designing interventions that can positively influence the adaptive capacity and adaptation practices of the smallholder farmers in the Municipality. Finally this research would add to existing literature based on observed evidence.

#### **1.4 Statement of Hypotheses**

**Hypothesis 1 H<sub>0</sub>:** There is no differential effect of climate change on the livelihoods of men and women smallholder farmers

**H<sub>A</sub>:** There is differential effect of climate change on the livelihoods of men and women smallholder farmers.

**Hypothesis 2 H<sub>0</sub>:** There is no difference in the coping strategies employed by smallholder farmers to safeguard their livelihood during climate change.

**H<sub>A</sub>:** There is a difference in the coping strategies employed by smallholder farmers to safeguard their livelihood during climate change.

## **1.5 Definition of Concepts**

### **1.5.1 Concept of Climate Change**

Climate is basically defined as an average weather conditions over a long period of time. Climate is seen as a composite of daily weather conditions that describe the average and variability typically over 30 year (CGIAR, 2009). The major elements of the weather are sunshine, rainfall, atmospheric pressure, humidity, wind direction and wind speed, solar radiation and ionization.

According to IPCC (2007), “Climate change refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persist for an extended period, typically decades or longer. Further, it can also refer to any change in climate over time, whether due to natural variability or as a result of human activity”. This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), which defines climate change as: “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods” (IPCC, 2007).

The operational definition for climate change was limited to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persist for an extended period, typically decades or longer.

### **1.5.2 Concept of Gender**

Gender refers to the differences in socially constructed roles and opportunities associated with being a man or a woman and the interactions and social relations between men and women. Gender determines what is expected, permitted and valued in a woman or a man in a determined context (UNDP, 2007).

According to UNDP (2007) these socially constructed roles can be group under four heading and they include reproductive; productive; community managing; and community politics role. Reproductive role encompasses not only biological reproduction but also the care and maintenance of the workforce. With women mostly undertaking this role. The productive role is basically concerned with work done by men and women for pay in cash or kind. For women in agricultural production, this includes work as independent farmers, peasant wives and wageworkers.

Community managing and community politics roles are activities undertaken primarily by women and men respectively as service to the community. The former is an extension of their reproductive role to ensure the provision and maintenance of scarce resources of collective consumption, such as water, fuel wood, health and education. Whiles the latter involves organizing formal political level often within the framework of national politics. (UNDP, 2007).

### **1.5.3 Concept of Livelihood**

The concept of livelihood dates back to the work of Robert Chambers in the mid- 1980s. According to Chamber and Conway (1992), “a livelihood comprises the capabilities, assets (including both material and social resource), and activities required for a means of living: a livelihood is sustainable when it can cope with and recover from stress and shocks, maintain and enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels in the short and long term”.

The Chambers and Conway definition was modified by DFID and states as “livelihood comprises the capabilities, assets (including both material and social resource), and activities required for a means of living: a livelihood is sustainable when it can cope with and recover from stress and

shocks, maintain and enhance its capabilities and assets both now and in the future whilst not undermining the natural resource base” (Carney, 1999).

#### **1.5.4 Concept of Coping Strategies**

The Oxford English Dictionary defines coping as “the action or process of overcoming a problem or difficulty”, or “managing or enduring a stressful situation or condition”. According to Taylor *et al.* (2010) “coping strategies are efforts or combination of activities employed by households to reduce their vulnerability to stresses and shocks (such as droughts, floods, coastal erosion etc.). These coping strategies are distinguished from adaptation strategies in the sense that the former is motivated by crisis and immediate, short-term, highly oriented towards survival as well as often degrades the resource base (Taylor *et al.*, 2010).

According to DFID (1999), the term coping strategies can be used to denote the range and combination of activities and choices that people make/undertake in order to achieve their livelihood goals in a given vulnerability context such as climate change. In other words the term coping strategies can be used interchangeably to represent livelihood strategies in a livelihood framework. This study adopts the DFID (1999) definition for coping strategies as its operational definition.

#### **1.6 Organization of the Study**

This study is organized into six chapters. Chapter one is concerned with the introduction; problem statement; objectives of the study; and definition of concepts. Chapter two reviews literature and also presents the theoretical and conceptual framework of the study. The first part of chapter three presents description of the study area; types of data to be collected; data collection methods; sampling method and size. The second part presents the method of analyses for each objective, statements and validation of hypotheses as well as the limitation of the study.

Chapter four and five analyses and present the results. The summary, conclusions and policy recommendations are presented in chapter six.



## **CHAPTER TWO**

### **REVIEW OF LITERATURE & THEORETICAL APPROACHES ON LIVELIHOOD**

#### **2.0 Introduction**

This chapter reviews literature relevant to the study. The first part of this chapter reviews literature on climate change evidence in Ghana, smallholder farmers' perception on climate change, climate change impacts on gender, climate change effects on rural livelihoods, strategies employed by smallholder farmers to safeguard their livelihoods in the face of climate change as well as literature on the role institutions play in assisting smallholder farmers adapt to climate change. The second part presents the various theories on livelihoods and also the conceptual framework for the study. Finally studies done on climate change effects on livelihoods are also presented in this chapter.

#### **2.1 Evidence of Climate Change in Ghana**

Ghana is a tropical country which experiences changes in weather elements. Ghana was documented to have completed its first National Communication to the United Nations Framework on Climate Change (UNFCCC) in 2000, which predicted the impacts of climate change. Furthermore, a study conducted by the Centre for Environmental Economics and Policy in Africa (CEEPA) in 2006 revealed changes in some of the climatic elements such as temperature, rainfall and sea levels in Africa, including Ghana.

According to CEEPA (2006) and MESTI (2015), the mean temperature in Ghana is expected to increase by 1.0°C to 3.0 °C by 2060, 1.5°C to 5.2 °C by the 2090s. This increase in temperature would however differ across the agro-ecological zones in Ghana with the northern inlands and

coastal regions being warmer (MESTI, 2015). Daze (2007) further documents that Sudan savannah zone in the Upper East region is predicted to experience the maximum temperature of 3°C by 2100, followed by the Guinea savannah in the Northern region of 2.5°C. In contrast, the Sudan savannah is however predicted to experience the least minimum temperature with the Transitional zone found in the Brong-Ahafo region of Ghana expected to experience the highest minimum temperature of 3°C by the year 2100.

Evidently rainfall amount and distribution in Ghana has fluctuated over the years. According to MESTI (2015), there has indeed been a 10 percent increased and 15 percent decreased in the seasonal rainfall pattern and distribution globally especially in the country. Annual rainfall in the country is projected to decrease between 9-27 percent by the year 2100. Notwithstanding, the Sudan savannah agro-ecological zone is however predicted to experience the highest decline in the amount of rainfall of 170.0mm by that year, followed by Deciduous Forest, Transitional zone and Guinea savannah, by 99.0mm, 78.0mm and 74.0mm respectively by the year 2100 with rainforest predicted to experience an increase of 110.0mm in the amount of rainfall by the year 2100 (MESTI, 2011).

CEEPA (2006) reports that although the amount of rainfall has decreased over the years and expected to decrease more in the coming years in Ghana, the level of sea has been reported to have increased by 2.1mm per year over the past 30 years. And this has been estimated to further increase by 1mm by the year 2100. This has been predicted to consequently result in future scenarios of earthquakes due to coastal erosion, intrusion of salt water into surface and ground sources.

## 2.2. Smallholder Farmers' Perception on Climate Change

Perception of smallholder farmers on climate change is very important in the sense that it accord them the opportunity to adapt and minimize its effect on agricultural production. There had been a lot of researches on perception on climate change in the developed countries where the relationship between scientists and indigenous people is very high (Jan and Anja, 2007). Though many researchers in African continent have looked at farmers' perception on climate change, it is not enough. Ishaya and Abaje (2008) and Fosu-Mensah *et al.* (2012) have examined the indigenous people's perception on climate change and adaptation strategies in Kaduna State of Nigeria and the Sekyere District of the Ashanti Region of Ghana respectively. The result of their study revealed that indigenous people perceived that climate had changed and still continues to change due to human activities.

Literature revealed that most smallholder farmers are aware that the climate has changed. Centre for Environmental Economics and Policy in Africa (CEEPA, 2006) highlighted that a high percentage of farmers in Africa have realized that the climate had change significantly. That study indicated that majority of farmers in Africa believe that precipitation had decreased considerably. It is an undeniable fact that a significant number of smallholder farmers also perceived temperature had increased over the years. Deressa (2008) indicated that smallholder farmers along the Nile Basin were aware that temperature was increasing and the level of precipitation was decreasing and this corresponds with meteorological evidence. Most literature established that it is well experienced farmers who perceived that climate has changed and continues to do so due to unfair treatment of the environment by humans (Deressa., 2008). It is therefore convenient for a researcher to look at the perception of farmers on climate change based on the respondents' years of farming experience. According to Maddison (2007), as

experience increases farmers are more likely to perceive changes in rainfall. To him, frequency of drought changes in the timing of rains increase with the number of years in farming.

Also, there are other factors that affect smallholder farmers' perception on climate change. These factors range from social to economic. Maddison (2007) indicated that there is the likelihood that smallholder farmers' perception on climate change may be determined by gender, marital status, years of education, whether the farmer is engaged in off-farm work or not, whether he or she is the head of a household or not. Distance from ones farm to the market centre, access to extension advice and access to weather information could also affect farmers' perception on climate change (Maddison, 2007).

### **2.3 Climate Change and Gender**

To start with, "sex" refers to the biological and physiological characteristics that define men and women (WHO, 2011). On the other hand, "gender" refers to socially constructed roles, behaviours, aptitude and relative power that a given society considers appropriate for men (male) and women (female) (Esplen, 2009; Aboud, 2011). In other words, "male" and "female" are sex categories, while "masculine" and "feminine" are gender categories. According to WHO (2011) aspects of sex will not vary substantially between different human societies, while aspects of gender may vary greatly.

In analysis of climate change, the gender approach is necessary to understand not only how the identities of women and men determine different vulnerabilities and capacities to cope with climate change impacts, but also how to tackle both the causes and consequences of climate change. It recognized that people who are already the most vulnerable and marginalized, experience the greatest impacts (IPCC, 2007). At the same time, they have the least capacity or

opportunity to prepare for the impacts of a changing climate (BRIDGE, 2008). As women constitute the largest percentage of the world's poorest people, they are the ones who would experience the greatest impact of these changes they are least responsible for and this is due to the gender roles assigned to them by society (WHO, 2011).

Women constitute about 20 to 60 per cent of the agricultural labour force in developing countries of the world (FAO, 2011). Specifically, females share of the agricultural labour force ranges from about 20 per cent in Latin America to about 50 per cent in Eastern and Southern-Eastern Asia and Sub-Saharan Africa (FAO, 2011). Women in Sub-Saharan Africa have relatively high overall labour force participation rates in the world (Prakash, 2003; FAO, 2011). The share of women in the agricultural labour force ranges from 36 per cent in Cote d'Ivoire and Niger to over 60 per cent in Lesotho, Mozambique, Sierra Leone and Ghana (FAO, 2011).

In developing countries of the world, studies have indicated that women are the most affected by the negative impacts of climate change (Bartlett, 2008; CARE Canada, 2010; Glazebrook, 2011; Nabikolo *et al.*, 2012; WHO, 2008b; Skutch, 2004). A study conducted by CARE Canada in Myanmar highlighted that out of 130,000 people that were dead or missing after a cyclone, 61 per cent were female and attributed this high percentage to women's inability to participate in social and educational events due to their reproduction role that leaves them no time to partake in extra activities (CARE Canada, 2010). Similarly, Bartlett (2008) concluded in his study that out of 40,000 households that experienced floods in Nepal, about 80 per cent (out of which 60 per cent were women and girls) suffered flood-related fatalities. And this was attributed to the gender-discriminatory practices that exist in the country. According to the World Health Organization, rising temperatures may increase transmission of malaria in some location and this

poses great health challenges for pregnant women who are highly vulnerable to malaria compared to the non-pregnant (WHO, 2008).

In agriculture, women are often engaged in subsistence farming and have lesser resources such as land, inputs available to them, extension services as well as few mechanism such as training and calamity insurance, compared to their male counterparts, which could help them become more resilient and respond to the impact of climate change as well as prepare them for the next impact of climate change (Leyesa, 2006). Furthermore, women farmers also experience exclusion from acquiring and holding resources such as land for farming due to some cultural and religious believes tending to lower their levels of adopting new farm technologies (FAO, 2009). And this has serious implications for attaining household food security since women are the main producers of food crops at the household level (FAO, 2009). Emphasizing on Ghana, rural women form about 52 per cent of the agriculture work force, and produce about 70 per cent of staple food crops (Duncan, 2004; MOWAC, 2012) at subsistence levels. The productivity of these women is however affected by socioeconomic and environmental barriers. These barriers include access to land, access to credit and lack of education (Duncan, 2004). Climate change, also affects women's productivity and their attainment of household food security since they are responsible for collecting water and providing food at home a situation that makes them highly vulnerable to climate change impacts (CARE Ghana, 2009).

In terms of climate change impacts on health, women and men suffer different negative health consequences, that is to say, more women often suffer than men (UNISR, 2008). According to a report by WHO and UNICEF, in times of drought, women have little choice but to carry heavy pots for longer distances in search of water daily for domestic use and this leaves enormous physical burden on them (WHO & UNICEF, 2006). Aside that, they are engaged in cooking,

cleaning, rearing of children and collection of firewood leaving them with no time to participate in social and educational programs (Oxfam, 2006). Also, women and girls may also face barriers to accessing health-care services due to poor control over economic and other assets to avail themselves of health care, and cultural restrictions on their mobility that may prohibit them from travelling to seek health care (WHO, 2008).

In conclusion, apart from the nutritional impacts of livelihood, household and caring burdens, decline in food security and livelihood opportunity resulting from climate change can also cause considerable stress for men and boys, given the socially ascribed expectation that they should provide economically for household. This according to Masika (2002) can lead to mental illness and deaths from suicides since men and boys are less likely than women and girls to seek help for stress and mental health issues.

#### **2.4 Climate Change and Agriculture**

The dependence of Sub-Saharan Africa on agriculture, a climate sensitive sector, is a major source of livelihood that cannot be overlooked. Researches have shown evidence of climate variability and changes globally in terms of temperature, precipitation as well as sea levels (Jones & Mann, 2004; IPCC, 2007). According to Alley *et al.* (2007), climate models have also been used to confirm changes in climatic factors to be a result of the decline in rainfall, extreme temperatures, among other observations. Thus climate change would adversely affect production and productivity of the resource rural poor farmers in the region.

These changes in climatic factors have been reported to cause both positive and negative effects. However in developing countries studies have indicated more negative effects that cut across crops, livestock as well as fisheries within the agricultural sector. Nelson *et al.* (2009) posited

that, variation in temperature caused adverse decline in crop production through increase in pest infestation. According to Ludi (2009) and FAO (2008), fluctuations in precipitation and prolonged drought negatively affect crop productivity.

Besides these impacts of climate change on crop productivity, there is evidence of impacts on livestock productivity as well as fishery production. Kabubo-Maria (2008), reports the effect of climate change on the quality of feed available for livestock production and productivity. Recent studies also claimed climate change directly affect the physiology, behaviour, growth, reproductive capacity, mortality and distribution of fisheries and also indirectly affect the productivity, structure and composition of the marine ecosystems which serves as food for the fisheries (Brander, 2010; Okunishi *et al.*, 2012).

The Ghanaian economy is agricultural driven with about 60 per cent of the population involved in the growing of crops and rearing of animals at the subsistence level as a means of survival (Alhassan & Dio, 2007). This implies that majority of land in the country is mainly used for agricultural cultivation (MoFA, 2008). Agricultural production in Ghana is still highly dependent on rainfall although initiatives have been put in place with the introduction of irrigation farming in recent years (MoFA, 2008). By implication, Ghana's agriculture is rainfall dependent; the production of crops and animals is entirely at the mercy of the weather. Highlighting on the impacts of climate change on crop productivity, Stutley (2010) confirms extreme temperature in Ghana to be the source of low yields in the crop production. Similarly, Mendelsohn *et al.* (2006) contended that, extreme temperatures and prolonged drought periods in Ghana were the major causes of low crop productivity.

According to Tonah (1993), Mensah-Bonsu (2003) and Fosu-Mensah (2013), planting periods for crops in Ghana have changed over the years from early April in the 1960's to late April or

early May. These changes were attributed to unpredictable nature of rains and the changing environmental conditions especially in the amount and distribution of rains. These changing rainfall regimes affected cereal, root and tuber crop productions (Daze, 2007; Sagoe, 2006 and Mabe *et al*, 2014). However, climate change does not only reduce crop productions thereby causing food insecurity at local or national levels but also increases the incidence of pests and diseases in crops posing serious threats to human health and the attainment of livelihoods (Ampaabeng & Tan, 2012).

## **2.5 Coping Strategies Employed by Rural Households to Secure Livelihood**

According to DFID's sustainable livelihoods glossary the term strategies denotes: "the range and combination of activities and choices that people make in order to achieve their livelihood goals". Therefore livelihood strategies include how people combine their income generating activities; the way in which they use their assets; which assets they chose to invest in; and how they manage to preserve existing assets and income (DFID, 1999). Livelihoods are diverse at every level; for example, members of a household may live and work in different places engaging in various activities, either temporarily or permanently. Individuals themselves may rely on a range of different income-generating activities at the same time (DFID, 2000). Rural areas are characterized by the presence of diverse economic activities in order to cope with risky events and achieve a sustainable income stream over time (Lopez, 2008). Some are farm related and others are not. Various researches have shown that non-farm activities were growing in importance especially in Africa accounting for 40-45 percent of average household income. (Barrett *et al.*, 2001; Little *et al.*, 2001; Reardon, 1997).

Ellis (1998) defines livelihood strategy as "the process by which rural families construct a diverse portfolio of activities and social support capabilities in their struggle for survival and in

order to improve their standards of living”. Households employ different strategies for various reasons. The literature aggregates the reasons under different categories. For example, for Ellis (1998), diversification occurs due to households’ pursuit of voluntary and involuntary strategies; for Von Brown and Paundya-lorch (1991) it is due to ex ante risk minimization and ex post coping strategies; for Barrett *et al.* (2001) due to push and pull factors, etc. This study Classify the reasons for diversification of livelihoods into involuntary or deliberate, ex ante and ex post strategies. The former refers to alternate livelihood strategies that households are forced to adopt in reaction to disasters such as climate change challenges (floods, droughts, heat spell etc.) and extreme weather events (Ellis, 1998; Ellis, 2000).

According to Alemu (2012) ex-ante livelihood strategies employed by rural households could be regarded as safety valves. They refer to push factors such as minimization of risks, liquidity constraints, labor, land, high transaction costs, and seasonality. Furthermore households try to stabilize their income by diversifying into livelihoods that are less susceptible to climate change and price variations (Alemu, 2012). In addition, lack of sufficient access to important farm requisites and assets could force households to look for additional or alternative sources of livelihoods (Gecho *et al.*, 2014). On the contrary households could also embark on deliberate ex-post livelihood strategies. These constitute activities that could be strategically allied to or are complementary to their primary source of income. Examples of this include integration of crop and livestock activities. Other examples of deliberate ex-post livelihood strategies include realization that they have comparative advantage in non-farm activities as demonstrated by high premiums; location advantage due to their proximity to commercial agriculture and urban areas with the potential to create off-farm and non-farm employment opportunities; and in response to diminishing returns on factors of production (Abdulai & CroleRess, 2001; Corral & Reardon,

2001).

According to Ellis (1998) and Barrett *et al.* (2001) rural households livelihood strategies can be classified on the basis of on-farm (livestock and crop production), off-farm (wage employment in other farms), and non-farm (non-agricultural income sources such as wage employment, self-employment, property income, government grants and remittances). This classification gives room to accommodate all the various livelihood strategies employed by rural households (Barrett *et al.*, 2001). Researches have shown that about 42 percent of rural households in Africa rely solely on on-farm activities for their livelihoods and this includes crop and livestock activities while the remaining 58 percent combines on-farm activities with non-farm and off-farm activities to sustain their livelihoods outcomes among which increase in income, improve well-being, reduce vulnerability as well as increase food security (DFID, 1999; Gecho *et al.*, 2014; Ghosh & Bharadwaj, 1992).

## **2.6 Role of Institutions in Adaptation to Climate Change**

According to IPCC (1997) “climate change impacts would be felt globally but adaptation to these impacts would need to be context specific as a result, there is the need to develop local adaptation measures to help address the challenge”. Because adaptation to climate change would need to occur locally, it is critically important to understand the role of local institutions if adaptation is to help the most vulnerable social group (Agrawal, 2008). According to Agrawal (2008), adaptation to climate change is highly local and its effectiveness depends on local and extra-local institutions through which incentives for individuals and collective actions are structured. Not only have existing institutions affected how rural people responded to environmental challenges in the past, they were also the fundamental mediating mechanisms that translate impact of external interventions to facilitate adaptation to climate change (Agrawal &

Perrin, 2008).

North (1990) defined institutions as “the rules of the game in a society or, more formally, the humanly devised constraints that shape human interaction”. Uphoff (1986) simply considers institutions as “rules that guide conduct in a system and shows that they operate at different levels: international, regional, national, and local”. For DFID (1999) institutions are “the organizations, both private and public, that set and implement policy and legislation, deliver services, purchase, and trade and perform all manner of other functions that affect people’s livelihood”.

According to Agrawal *et al.* (2008) institutions can be grouped under three main domains. These include public, civic, and private institutions. But within these three broad domains, two important types of local public institutions: local governments (organizations accountable to a local constituency through elections or some other mechanisms) and local agencies (agencies or arms of higher levels of government operating at local levels). They similarly identify two types of civic institutions (membership organizations that function in a manner analogous to companies and advance some common interest of their members; and cooperatives which functions more like partnership and help members pool resources for improved economic outcomes) and two types of private institutions (service organizations including NGOs and charities and private businesses). These institutions according to Agrawal *et al.* (2008) mediate and shape adaptation practices in various ways (mobility, storage, diversification, communal pooling, and exchange), and contribute to livelihood outcomes for households through external interventions (such as information and training, technology, funds, and leadership). These interventions can be viewed as mechanisms to provide resources necessary to enhance adaptive capacity, and whether they actually increase adaptive capacity of resilience depends on the manner in which they become

available, the people who gain access to them and the institutional means of their provision (Agrawal, 2008).

It is contended that all three types of institutions play a crucial role in shaping adaptation to climate change by: connecting households to local resources and collective action; determining flows of external support to different social groups; and linking local populations to national interventions (Agrawal *et al.*, 2008).

Public institutions are for governance or administration. They use state funds to provide basic information, infrastructure, and services (including law and order) to communities. Their activities are controlled by the state (Gertler & Wolfe, 2004; Kirsten *et al.*, 2009). According to Agrawal *et al.* (2008), public institutions are likely to facilitate adaptation strategies related to communal pooling, diversification and storage owing to their command over authoritative action and ability to channel technical and financial inputs into rural areas. Agrawal (2008) asserted that public institutions were very relevant in adapting to climate change due to the fact that they provide external interventions in the form of information, training and technology which builds the adaptive capacity of rural people as well as improve upon their livelihood. This assertion was seconded by Adjei-Nsiah and Kermah (2012) who in their study concluded that public institutions such as the Ministry of Food and Agriculture (MoFA) and the Forestry Commission (FC) provided improved cocoa seedlings and training in cocoa agronomy to rural farmers in Wenchi to help them mitigate and adapt to the negative impacts of climate change. Also a study conducted by Egyir *et al.* (2013) also documented public institution such as MoFA and FC partnering with informal institutions such as clan heads, family heads, and community leadership groups to implement forest protection regulations aimed at enabling rural households mitigate

and adapt to climate change.

Civic institutions are any institution that exists separate from the state and market. In other words, it is one that is not engaged in governance or business (Agrawal, 2008). According to Uphoff and Bucks (2006) they are voluntary organizations that include service organizations and membership organizations. Service organizations may be faith-based or benevolent societies called non-governmental organizations (NGOs), media houses that provide free airtime for discussion of development issues, and other civil society organizations. While membership organizations are NGOs that patronize their own services (Uphoff & Bucks, 2006). They include formal, semi-formal, and informal farmer organizations and cooperatives, trading groups, and CBOs. Members of such groups benefit from information, credit, infrastructure, and other services obtained and offered by the group. According to Newell (2008), civil institutions assist in adaptation to climate change by basically providing information, transfer of technology, leadership and to some extent credit interventions. Similarly, Agrawal (2008) asserted that most farmer based organizations or cooperatives assist communities to adapt to climate change by organizing forums and sensitizing members of the communities on reducing deforestation and water pollution and engaging in alternative livelihoods such as livestock keeping (including bees), handicraft, and agro processing. In some cases they provided a range of services such as provision of inputs (e.g. improved seeds, fertilizer etc.), training in agronomy, and advocacy, to support households in climate change adaptation (Yaro *et al.*, 2010).

Finally, private institutions include corporations, partnerships, and sole proprietorship companies that target profit as they offer services. However, the phenomenon of corporate social responsibility and sustainable supply chains has led for-profit organizations to consider social activities that provide services to support physical infrastructure or environmental soundness

(Hill *et al.*, 2007). Private institutions because of their access to financial resources are more likely to have greater expertise in providing market exchange and diversification adaptation practices compared to the other institutions but may also be able to advance communal pooling if one takes not-for profit service organization (Agrawal, 2008). According to the United Nations Framework Convention on Climate Change (UNFCCC), private organizations (sometimes in partnership with NGOs or the public sector) have assisted to address climate change challenges in vulnerable communities by providing capacity building, education, and training; provision of resources to support food, agriculture, forestry, and fisheries; support for science research, assessment, monitoring, and early warning; and interventions in water resources ([www.unfccc.int/adaptation](http://www.unfccc.int/adaptation)). In Ghana private institutions noted for providing support for “sustainable development projects” and climate innovation projects include Eco bank, Standard Chartered Bank, Stanbic, Barclays Bank, and E+Co (USAID & MFCS, 2014).

## **2.7 Theoretical Approaches on Livelihoods**

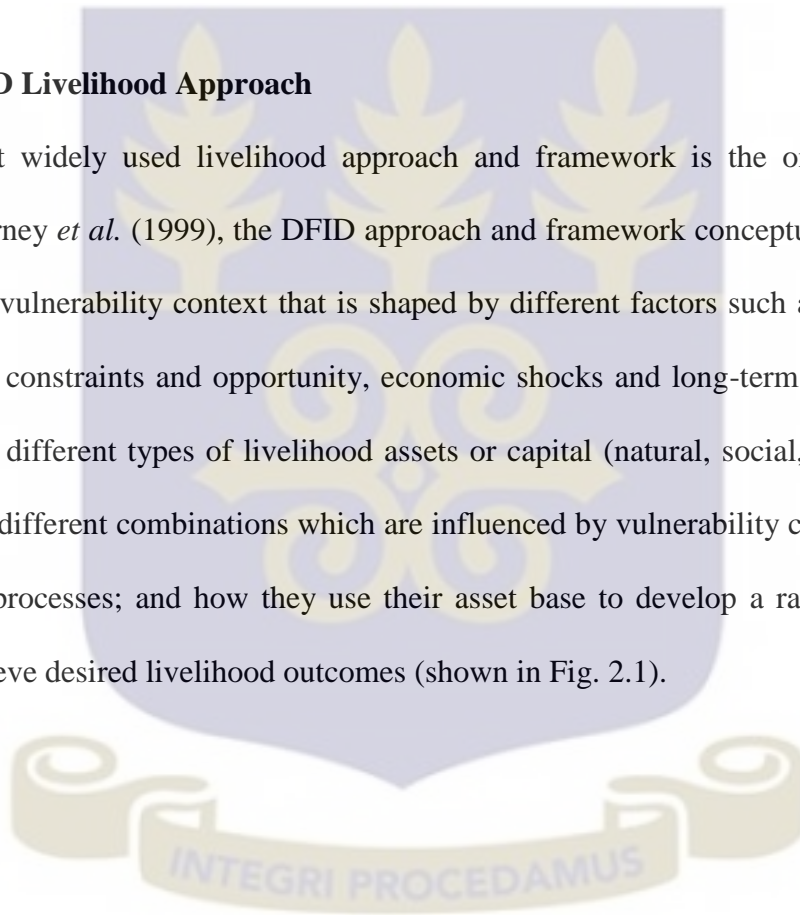
This section provides a brief overview of the various livelihood approaches that exist. The aim is to clarify understanding of the fundamental principles behind the livelihood approaches and the justification for the adoption of a particular livelihood approach for this study. Specifically this overview covers the livelihood approaches that are implemented by four different agencies specifically: the United Kingdom Department for International Development (DFID); Cooperative for Assistance and Relief (CARE); Oxfam Committee for Famine Relief (Oxfam); and the United Nations Development Programme (UNDP).

According to Carney *et al.* (1999) all the various livelihood approaches are closely linked to the work of Chambers and Conway (1992). In other words, the foundation for all the livelihood approaches were strongly built from Chambers and Conway’s definition for livelihood, which

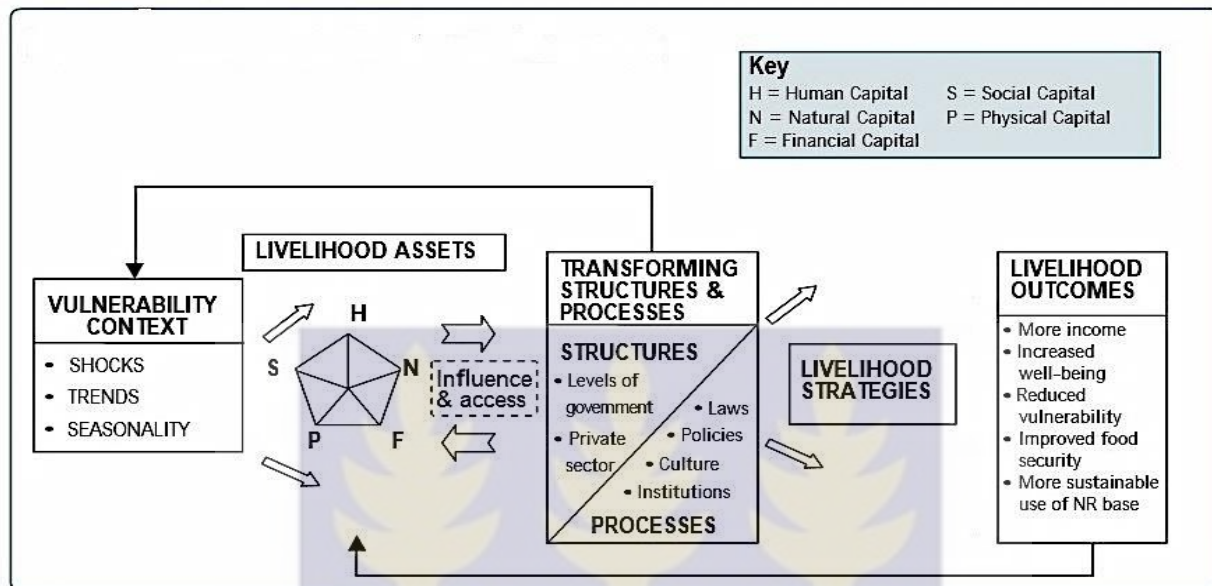
states that “a livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living. Further, a livelihood is sustainable when it can cope with and recover stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation and which contributes net benefits to other livelihoods at the local and global levels and in the long and short term” (Chambers & Conway, 1992).

### **2.7.1 The DFID Livelihood Approach**

One of the most widely used livelihood approach and framework is the one by the DFID. According to Carney *et al.* (1999), the DFID approach and framework conceptualize how people operate within a vulnerability context that is shaped by different factors such as natural shocks, shifting seasonal constraints and opportunity, economic shocks and long-term trends; how they draw on the five different types of livelihood assets or capital (natural, social, physical, human and financial) in different combinations which are influenced by vulnerability context, a range of institutions and processes; and how they use their asset base to develop a range of livelihood strategies to achieve desired livelihood outcomes (shown in Fig. 2.1).



**Figure 2.1. The DFID Livelihood Framework**



(Source Carney et al., 1999)

The DFID framework is underpinned by certain core concepts, which makes its adoption very easy and relevant in livelihood analysis (DFID, 1999). Among the concepts includes, it is people centred in the sense that it advocates: (i) that development policy and practice should flow from an understanding of the poor and their livelihood strategies; (ii) the poor should directly contribute to determining development priorities and be able to influence the institutions and process that impact on their lives.

Secondly it is a holistic approach that encourages analysis across different sectors and recognizes a range of actors and influences as well as multiple livelihood strategies and outcomes. Also it is dynamic in nature in that it tries to understand change over time and the complex interplay between different factors as well as considers the linkages between micro and macro levels. Finally it starts from an analysis of strengths rather than needs and problems (DFID, 1999).

In its simplest form, the framework depicts stakeholders as operating in Context of

**Vulnerability**, within which they have access to certain **Assets**. These gain their meaning and value through the prevailing social, institutional and organizational environment (**Transforming Structures and Processes**). This context decisively influences the **Livelihood Strategies** that are open to people in pursuit of their self-defined beneficial **Livelihood Outcomes**. In other words, the framework provides a checklist of important issues and sketches out the way these links to each other, while it draws special attention to core influences and processes and their multiple interactions in association to livelihoods. The following subsections presents, defines and explains the core ideas in the DFID Livelihood Framework.

#### **2.7.1.1. Vulnerability Context**

The Vulnerability Context forms the environment in which people exist and gain importance through direct impacts upon people's asset status (Devereux, 2001). It comprises trends (i.e. demographic trends, resource trends, trends in governance); shocks (i.e. human, livestock or crop health shocks, natural hazards e.g. floods or droughts, economic shocks, conflicts in the form of national or international wars); and seasonality (i.e. seasonality of prices, products or employment opportunities) and represents the part of the framework that lies furthest outside stakeholder's control.

Not all trends and seasonality must be considered as negative; they can move in favorable directions too, for instance, trends in new technologies or seasonality could be used as opportunities to secure livelihoods (Kollmair & Gamper, 2002). According to DFID (1999), different components of the Vulnerability Context affect different people in different ways. Thus, natural shocks may have a more adverse effect on agricultural activity than on urban employment. Likewise, changes in international commodity prices will affect those who grow, process or export such commodities but have little direct effect on those who produce for, or

trade in, the local market. Hence understanding the nature of vulnerability is a key step in sustainable livelihood analysis (DFID, 1999).

### **2.7.1.2. Livelihood Assets**

The livelihoods approach is concerned first and foremost with people. So an accurate and realistic understanding of people's strengths (here called "assets" or "capital") is crucial to analyze how they endeavor to convert their assets into positive livelihood outcomes (Bebbington, 1999). People require a range of assets to achieve their self-defined goals, whereas no single capital endowment is sufficient to yield the desired livelihood outcomes on its own. This is particularly true for poor people whose access to any given category of assets tends to be very limited. As a result they have to seek ways of nurturing and combining what assets they do have in innovative ways to ensure survival (DFID, 1999).

The DFID Livelihood Approach presents five core asset categories or types of capital upon which livelihoods are built (DFID, 2000), and these are namely human capital; social capital; natural capital; physical capital and financial capital. Although the term 'capital' is used, not all the assets are capital stocks in the strict economic sense of the term (in which capital is the product of investment which yields a flow of benefits over time). Hence the term 'capital' is used because this is the common designation in the literature. According to Kollmair and Gamper (2002), assets are of special interest for empirical research in order to ascertain, if those, who were able to escape from poverty or livelihood challenges, started off with a particular combination of assets and if such a combination would be transferable to other livelihood settings. Also these assets types are important in this study since they forms the foundation for building rural livelihoods hence any impact (be it shocks from climate change) on them is likely to adversely influence the attainment of rural livelihoods.

#### **2.7.1.2.1. Human Capital**

In the field of development studies, human capital is a very wide used term with various meanings. However, in the context of DFID livelihood framework, it is defined as “the skills, knowledge, ability to labor and good health that together enable people to pursue different livelihood strategies and achieve their livelihood objectives” (DFID, 2000). At a household level human capital is a factor of the amount and quality of labor available; this varies according to household size, skill levels, leadership potential, health status, etc.

Human capital appears in the generic framework as a livelihood asset, that is, as a building block or means of achieving livelihood outcomes. Its accumulation can also be an end in itself. Many people regard ill health or lack of education as core dimensions of poverty and thus, overcoming these conditions may be one of their primary livelihood objectives (DFID, 2000). As well as being of intrinsic value, human capital (knowledge and labor or the ability to command labor) is required in order to make use of any of the four other types of assets. It is therefore necessary, though not on its own sufficient, but for the achievement of positive livelihood outcomes (Kollmair & Gamper, 2002).

#### **2.7.1.2.2. Social Capital**

There is much debate about what exactly is meant by the term ‘social capital’. In the context of DFID it is taken to mean the social resources upon which people draw in pursuit of their livelihood objectives. These are developed through “network and connectedness”, that increase people’s trust and the ability to cooperate or “membership in more formalized groups” and their systems of rules, norms and sanctions (DFID, 2000). Quite often access and amount of social capital is determined through birth, age, gender or caste and may even differ within a household. Obviously and often parallel to positive impacts, social capital may also cause effects that are

restrictive for development (Kollmair & Gamper, 2002). For instance the membership in groups always entails excluding other stakeholders; or the social affiliation to a certain caste may be positive or negative depending on the person's hierarchical position within the system.

Still, it is important through its direct impact on other capitals by improving the efficiency of economic relations or by reducing the 'free rider' problems associated to public goods through the mutual trusts and obligations it poses onto the community (DFID, 2000). And for the most deprived, social capital often represents a place of refuge in mitigating the effects of shocks or lacks in other capital through informal networks. Of all the five livelihood building blocks, social capital is the most intimately connected to Transforming Structures and Processes. In fact, it can be useful to think of social capital as a product of these structures and processes, though this over-simplifies the relationship. Structures and processes might themselves be products of social capital; the relationship goes two ways and can be self-reinforcing (DFID, 2000).

#### **2.7.1.2.3. Natural Capital**

Natural capital is the term used for the natural resource stocks from which resource flows and services (e.g. nutrient cycling, erosion protection) useful for livelihoods are derived. There is a wide variation in the resources that make up natural capital, from intangible public goods such as the atmosphere and biodiversity to divisible assets used directly for production (trees, land, etc.) (DFID, 2000). Within the framework, the relationship between natural capital and the vulnerability context is particularly close. Many of the shocks that devastate the livelihoods of the poor are themselves natural processes that destroy natural capital (e.g. fires that destroy forests, floods, droughts and earthquakes that destroy agricultural land) and seasonality is largely due to changes in the value or productivity of natural capital over the year (DFID, 2000).

Clearly, natural capital is very important to those who derive all or part of their livelihoods from resource-based activities (farming, fishing, gathering in forests, mineral extraction, etc.) (Nicol, 2000). However, its importance goes way beyond this. None of us would survive without the help of key environmental services and food produced from natural capital. Health (human capital) will tend to suffer in areas where air quality is poor as a result of industrial activities or natural disasters (e.g. forest fires) (Ellis, 2000). And although our understanding of linkages between resources remains limited, we know that we depend for our health and wellbeing upon the continued functioning of complex ecosystems (which are often undervalued until the adverse effects of disturbing them become apparent).

#### **2.7.1.2.4. Physical Capital**

According to DFID (2000), physical capital comprises the basic infrastructure and producer goods needed to support livelihoods, such as affordable transport; secure shelter and buildings; adequate water supply and sanitation; clean, affordable energy; and access to information. Its influence on the sustainability of a livelihood system is best fit for representation through the notion of opportunity costs or trade-offs, as a poor infrastructure can preclude education, access to health services and income generation. For example, without irrigation facilities long periods are spent in non-productive activities, such as collection of water, needing extra labor force, that could be used elsewhere (Calow, 2001). Also, without transport infrastructure, essential fertilizers cannot be distributed effectively, agricultural yields remain low and it is then difficult and expensive to transport limited produce to the market. The increased cost (in terms of all types of capital) of production and transport means that producers operate at a comparative disadvantage in the market (Ashley, 2000).

According to Nicol (2000) infrastructure is commonly a public good that is used without direct

payment. Exceptions include shelter, which is often privately owned, and some other infrastructure that is accessed for a fee related to usage (e.g. toll roads and energy supplies). Producer goods may be owned on an individual or group basis or accessed through rental or ‘fee for service’ markets, the latter being common with more sophisticated equipment.

#### **2.7.1.2.5. Financial Capital**

Financial capital denotes the financial resources that people use to achieve their livelihood objectives. The definition used here is not economically robust in that it includes flows as well as stocks and it can contribute to consumption as well as production (DFID, 2000). However, it has been adopted to try to capture an important livelihood building block, namely the availability of cash or equivalent, which enables people to adopt different livelihood strategies (Kollmair & Gamper, 2002).

According to DFID (2000), there are two main sources of financial capital:

- Available stocks: Savings are the preferred type of financial capital because they do not have liabilities attached and usually do not entail reliance on others. They can be held in several forms: cash, bank deposits or liquid assets such as livestock and jewelry. Financial resources can also be obtained through credit-providing institutions.
- Regular inflows of money: The most common types of inflows are labor income, pensions, or other transfers from the state, and remittances. In order to make a positive contribution to financial capital these inflows must be reliable (while complete reliability can never be guaranteed there is a difference between a one-off payment and a regular transfer on the basis of which people can plan investments)

Among the five categories of assets, financial capital is probably the most versatile as it can be

converted into other types of capital or can be used for direct achievement of livelihood outcomes (e.g. purchasing of food to reduce food insecurity). However, it tends to be the assets the least available for the poor (Kollmair & Gamper, 2002).

### **2.7.1.3. Transforming Structures and Processes**

According to the DFID's Livelihood Framework, "Transforming Structures and Processes" represent the institutions, organizations, policies and legislations that shape livelihoods. They are of central importance as they operate at all levels and effectively determine access, terms of exchange between different types of capital, and return to any given livelihood strategy (Shankland, 2000; Keeley, 2001). In addition, they have a direct impact upon whether people are able to achieve a feeling of inclusion and wellbeing. Because culture is included in this area they also account for other 'unexplained' differences in the 'way things are done' in different societies (DFID, 2000).

According to DFID (2000), structures can be described as the hardware (private, civic and public organization) that set and implement policy and legislation, deliver services, purchase, trade and perform all manner of other functions that affects livelihoods. An absence of well working structures often constitute an obstacle to sustainable development and makes simple asset creation difficult in case of adverse structure impeding access to apply a certain livelihood strategy.

Complementary to structures, processes constitute the software determining the way in which structures and individuals operate and interact (DFID, 2000). There are many types of overlapping and conflicting processes operating at a variety of levels and like software, they are crucial and complex. Important processes for livelihoods are for instance policies, legislation

and institution, but also culture and power relations. Processes may also serve as incentives for people to make choices, they may be responsible for access to assets or they may enable stakeholders to transform and substitute one type of assets through another (Kollmair & Gamper, 2002).

Transforming structures and processes occupy a central position in the framework and directly provide a feedback to the vulnerability context whiles influencing and determining ecological or economic trends through political structures. They also mitigate and enforce effects of shocks or keep seasonality under control through working market structures; or they can restrict people's choice of livelihood strategies and may thus have a direct impact on livelihood outcomes.

#### **2.7.1.4. Livelihood Strategies**

Livelihood strategies comprise the range and combination of activities and choices that people undertake in order to achieve their livelihood goals (DFID, 2000). According to Kollmair and Gamper (2002), livelihood strategies need to be understood as a dynamic process in which people combine activities to meet their various needs at different times and on different geographical or economical levels, within a household. Their dependence on assets status and transforming structures and processes becomes clear through the position they occupy within the framework. A changing asset status may further hinder other strategies depending on the policies and institutions at work.

#### **2.7.1.5. Livelihood Outcomes**

The livelihood outcomes according to DFID (2000) and Kollmair and Gamper (2002) are the achievements of livelihoods strategies, such as more income (e.g. cash); increase wellbeing (e.g. non material goods, like self-esteem, health status, access to services, sense of inclusion);

reduced vulnerability (e.g. better resilience through increase in assets status); improved food security (e.g. increase in financial capital to purchase food); and a more sustainable use of natural resources (e.g. appropriate property rights).

Livelihood outcomes are important because it helps understand the output of the current configuration of factors within the livelihood framework; it demonstrates what motivates stakeholders to act the way they do and what their priorities are (DFID, 2000). Also, livelihood outcomes gives an idea of how people are likely to respond to new opportunities and which performance indicators should be used to assess support activity (Kollmair & Gamper, 2002). In addition, livelihood outcomes directly influence the assets and change dynamically the form of the asset pentagon offering a new starting point for other strategies and outcomes (DFID, 2000; Kollmair & Gamper, 2002).

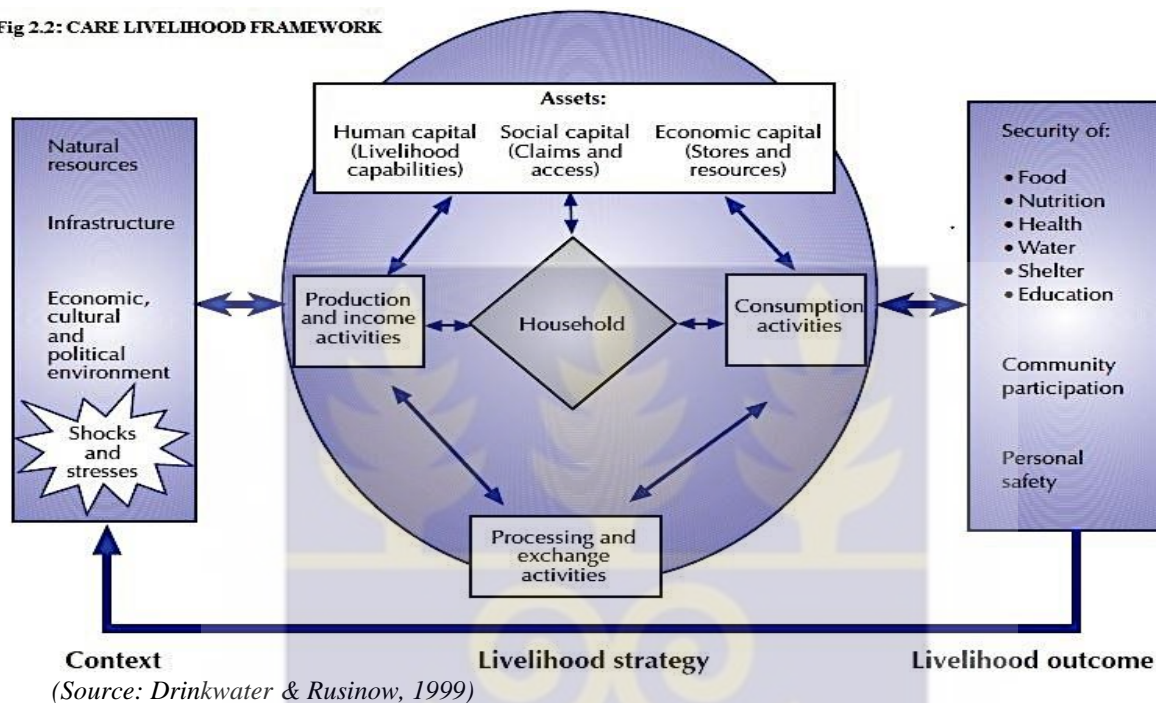
### **2.7.2. The CARE Livelihood Approach**

Contrary to the DFID's Livelihood Approach and framework, which serves as tool for monitoring and analysing the livelihood of the poor, the livelihood approach and framework of CARE is that of a programme-planning framework (Drinkwater & Rusinow, 1999). According to Drinkwater and Rusinow (1999), based on Chambers and Conway livelihoods definition, CARE's livelihood approach is centred on three fundamental attributes namely: the possession of human capabilities; access to tangible and intangible assets; and the existence of economic activities.

CARE's approach is similar to DFID in that it emphasises the dynamic interrelationships between different aspects of the framework, however rather than looking at using the five

capitals approach to assets, it distinguishes between assets, capabilities and activities (Drinkwater & Rusinow, 1999). This is illustrated in fig 2.2.

**Fig 2.2: CARE LIVELIHOOD FRAMEWORK**



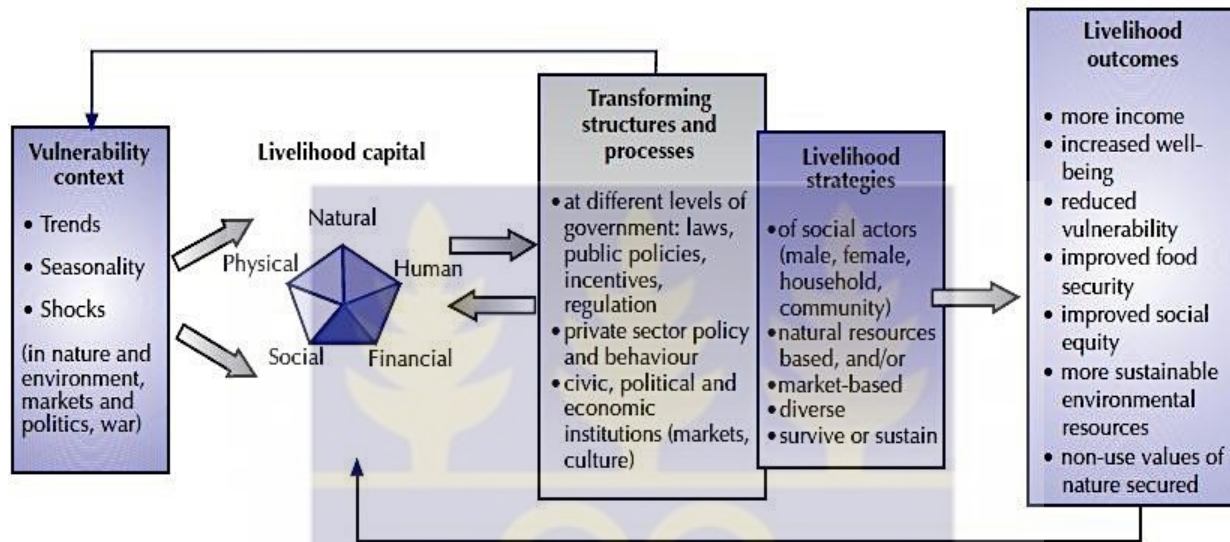
Also CARE’s framework does not explicitly identify transforming structures and processes and places less emphasis on macro-micro links within the framework, although these are important in livelihood analysis (Carney *et al.*, 1999).

### 2.7.3. The Oxfam Livelihood Approach

Similar to the other two livelihoods approaches, the Oxfam livelihood approach also draws on Chambers and Conway for its definition of sustainable livelihoods and emphasises that sustainability has four different dimensions, namely economic (for example, the functioning of credit and market supply); social (networks of reciprocity, gender equity); institutional (capacity building, access to service and technology, political freedom); and ecological (quality and availability of environmental resources) (Carney *et al.*, 1999). The Oxfam livelihood approach is

right-based, meaning everyone has the right to a sustainable livelihood (Drinkwater & Rusinow, 1999).

**Fig 2.3: Oxfam Livelihood Framework**



(Source: Drinkwater & Rusinow, 1999)

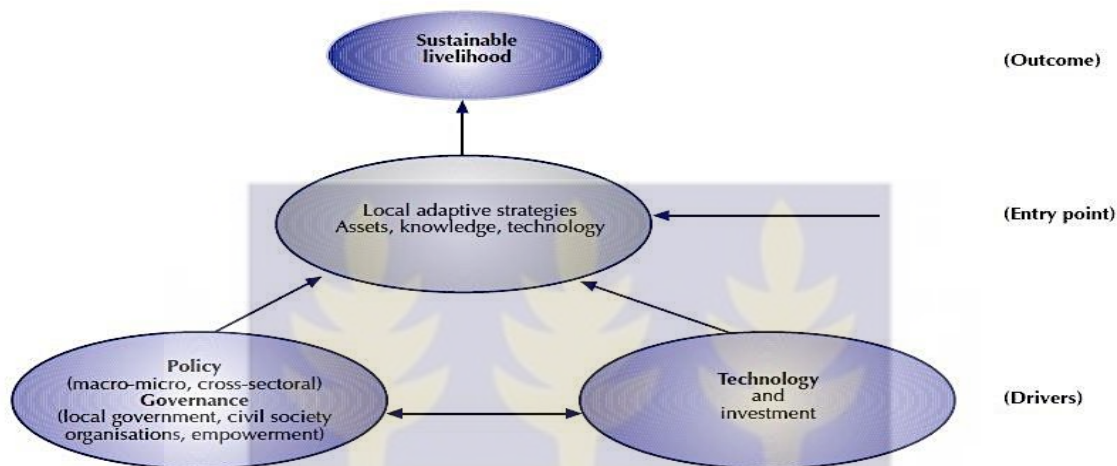
Like DFID, Oxfam uses a livelihood framework that is flexible (Fig. 2.3), however unlike DFID, Oxfam’s livelihood approach emphasises that there are no established rules governing the use of the framework (Drinkwater & Rusinow, 1999).

#### 2.7.4 The UNDP Livelihood Approach

The United Nations Development Program (UNDP) understands livelihoods as the means, activities, entitlements and assets by which people make a living. According to UNDP sustainable livelihoods are defined as those that are: (i) able to cope with and recover from shocks and stresses; (ii) economically effectively; (iii) ecological sound and; (iv) socially equitable (DFID, 1999). Like the DFID approach to livelihood, the UNDP livelihood approach also focuses on people’s strengths rather than their needs and emphasizes the importance of making a micro-macro link but unlike the other agencies livelihood approaches reviewed, that of

UNDP explicitly focuses on the importance of technology and investment as a means to help people secure a livelihood (Carney *et al.*, 1999). The framework is presented in fig 2.4 below.

**Fig 2.4 UNDP Livelihood Framework**



(Source: Carney *et al.*, 1999)

This study adopts the DFID and Oxfam livelihood approaches and framework. These frameworks due to its people-centered principle offers the opportunity to analyze and monitor how men and women smallholder farmers in a vulnerable context, which in this study is a changing climate, with various sets of assets/capitals employing various strategies secure their livelihoods.

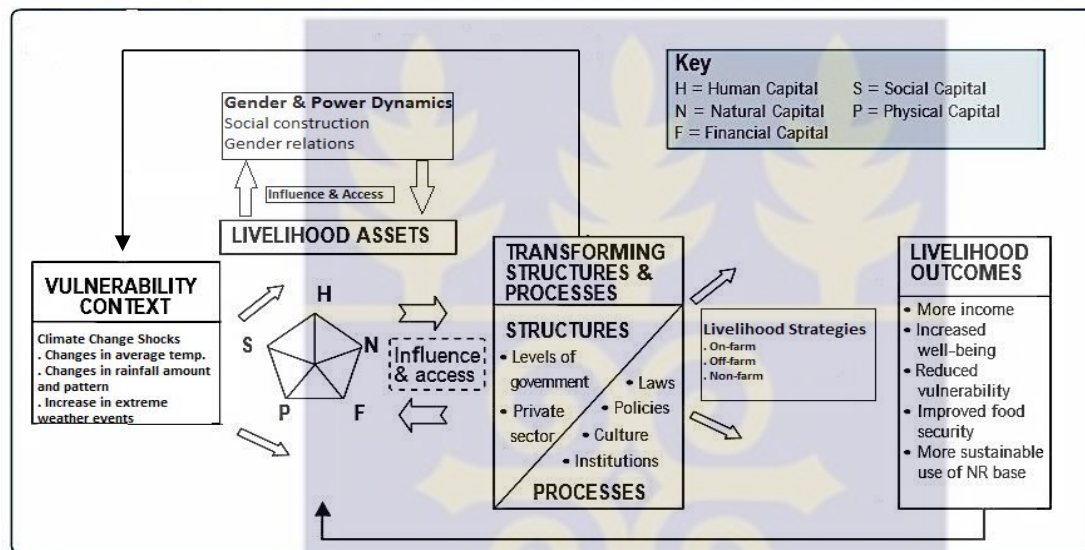
Also these frameworks provide a platform for identifying how institutions and their processes tend to affect how men and women adapt to a changing climate as well as how they influence the attainment of their livelihoods.

In conclusion, due to the dynamic and holistic nature of the DFID and Oxfam’s livelihood frameworks, they encourage analysis across different sectors and recognize a range of actors and influences as well as multiple livelihood strategies and outcomes (Carney, 1999).

## 2.8 Conceptual Framework for the Study

This study adopts the DFID and Oxfam Livelihood Approaches and Frameworks to explain how climate change and extreme weather events would impact on the livelihoods of men and women small-holder farmers in the Ejura/Sekyedumasi Municipal.

**Fig. 2.5 Conceptual Framework for the Study**



(Source: DFID, 1999; Oxfam, 2009)

The livelihood framework presented in Fig 2.5 presents the main factors that affect men and women smallholder farmers' livelihoods and the typical relationships between these factors. This framework shows that livelihoods are shaped by a multitude of different factors and forces, which include "vulnerability context", "gender and power dynamics", "transforming structures and process", "livelihood strategies", and "livelihood outcomes", that are all constantly shifting, but are ultimately centered on gender and climate change. Gender-centered analysis begins with simultaneous investigation of men and women's assets, their objectives (i.e. the Livelihood Outcomes which they are seeking), and the livelihood strategies that they adopt to achieve these objectives (Carney *et al.*, 1999).

The smallholder farmers engage in various activities using assets (natural, social, financial, human and physical asset) in an environment characterised by climate shocks such as changes in temperature and variation in rainfall to achieve their livelihood outcomes. The acquisition and usage of these assets are mostly influenced by gender and power dynamics as well as institutions through laws and policies in the society. Therefore in order for these smallholder farmers to achieve their livelihood outcomes (either more income, improve food security, reduce vulnerability etc.), they must adopt various strategies (i.e. on-farm, non-farm and off-farm) in the prevailing vulnerability context.

## **2.9 Empirical Studies on Climate Change effects on Rural Livelihoods**

A number of empirical studies show the impact of climate change on livelihoods especially in developing countries (Dahal, 2011; Gebretsadik, 2012; Nhemachena *et al.*, 2014; Phuong, 2012; Reid and Vogel, 2006; Amikuzuno, 2013; Mabe *et al.*, 2014). These studies had employed different research methods to analyze the impact of climate change on rural livelihoods predominantly on agriculture. For example, Reid and Vogel (2006) used the DFID Sustainable Livelihoods Framework to identify constraints to secure livelihoods that were being faced by small-scale farmers in the Muden area of KwaZulu- Natal. Their study revealed that among the constraints climate change impacts was the major concern of the farmers and this adversely affected their agricultural based livelihoods. A similar study was conducted by Phuong (2012) in Vietnam by employing a qualitative perspective to analyze the differential impacts of climate change on the livelihoods of both men and women farmers. The study highlighted that climate change impacts are more pronounced on the livelihoods of women than men due to their socially constructed roles. By using the DFID Sustainable Livelihood Framework, Phuong (2012) was also able to identify the various livelihoods constraints and livelihood strategies that both genders

are using to safeguard their livelihoods in the face of climate change and extreme weather events.

In Ghana, studies conducted on climate change have focused primarily on the impacts on the agricultural based livelihoods and the attainment of household food security (Akudugu *et al.*, 2012; Hesselberg and Yaro, 2006; Yaro, 2002; Mabe *et al.*, 2014). By also drawing from the DFID Sustainable Livelihood Framework, Akudugu *et al.* (2012) and Hesselberg and Yaro (2006) highlighted the adverse impacts of climate change on rural livelihoods in Northern Ghana by also employing the qualitative technique.

Contrary to Akudugu *et al.* (2012) and Hesselberg and Yaro (2006), Amikuzuno (2013) in his study on climate change impacts on rural livelihoods, specifically on agricultural activities around the White Volta Basin of the Upper East Region of Ghana, employed the Tradeoff Analysis Model for Multi-Dimensional Impact (TOA-MD) (quantitative technique) to analyze climate change impacts on rural livelihoods. The results of the study showed that climate change challenges negatively affected rural livelihoods as well as their attainment of livelihoods outcomes such as increase in income and improve food security (Amikuzuno, 2013). Similarly, a study by Fosu-Mensah (2013) also estimated the effect of climate change on rural livelihood using the quantitative approach specifically the IMPACT model. This study also showed a negative effect of climate change on rural livelihoods.

## CHAPTER THREE

### STUDY AREA AND METHODOLOGY

#### 3.0 Introduction

The first part of this chapter presents the study area, types of data collected, data collection methods, sampling methods as well as sample size. The second part presents the method of analyses for each objective. The scope of the study is also presented in chapter three.

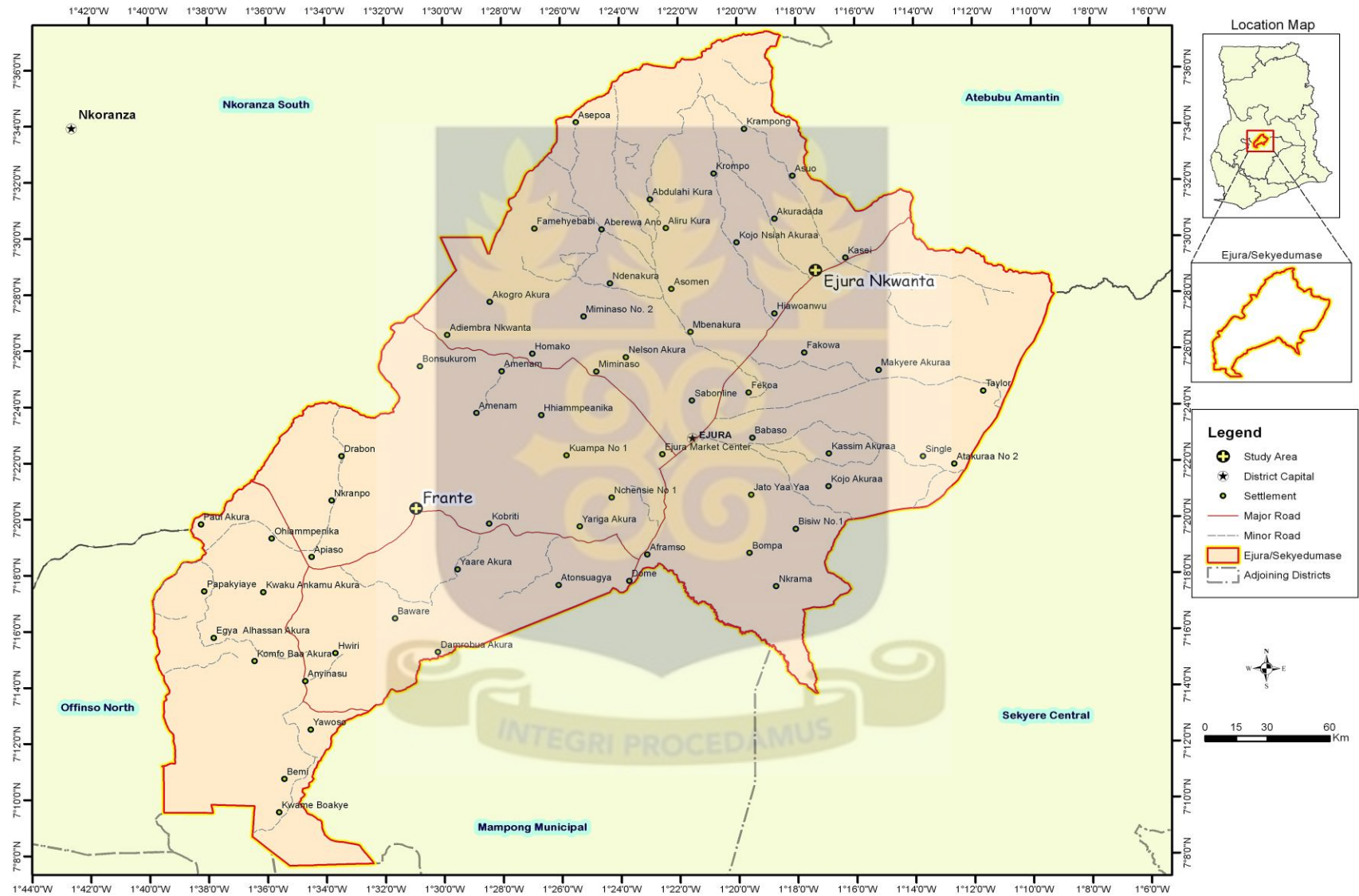
#### 3.1 Description of Study Area

##### 3.1.1 Location and Physical Features

Ejura/Sekyedumasi Municipal is located within longitudes 1°5'W and 1°39' W and latitudes 7°9' N and 7°36'N. It has a large land size of about 1,782.2sq.km. (690.781sq.miles) and is the fifth largest district in Ashanti region's 30 districts. Ejura is the administrative capital as shown in Figure 3.1.

It constitutes about 7.3% of the region's total land area with about one third of its land area lying in the Afram Plains. The Municipality is located in the Northern part of the Ashanti Region and is bounded in the north by Atebubu and Nkoranza districts (both in the Brong Ahafo region), on the west by Offinso district, on the East by Sekyere East district and the South by Sekyere West and Afigya Sekyere district (MLGRD, 2006).

**Fig 3.1. Map of Study Area**



(Source: CERSGIS)

The landscape in the southern part of the Municipality is fairly rolling with valleys and peaks. Averagely, the valleys have a depth of about 135m whilst the peaks rise to about 315m above sea level. On the other hand, the northern part is undulating and fairly flat with heights ranging between 150-300m. The Municipality is dissected and well drained by number of rivers, streams and their tributaries. The drainage is dendritic in nature and has a west-east and northwest-southeast directional flow. Major rivers include; Afram, Akobaa, Chirade, Bresua whilst minor ones include Aberewa, Yaya and Baaba (MLGRD, 2006).

In terms of climate and vegetation, Ejura/Sekyedumase lies within the transitional zone of the semi-deciduous forest and Guinea Savannah zones. Thus, it experiences both the forest and savannah climatic conditions. The Municipality is marked by two rainfall patterns; the bi-modal pattern in the south and the uni-modal in the north. The main rainy season is between April and November. The northeast trade winds blow dry and dusty winds across the entire Municipality during this period. Annual rainfall varies between 1,200mm and 1,500mm. Relative humidity is very high during the rainy season, recording 90 percent in its peak in June and 55 percent in February. Solar radiation is very high during the dry season (MLGRD, 2006).

The vegetation characteristics in the Municipality are to a large extent dictated by the topography, climatic condition and patterns. The northern part is covered with sparse derived deciduous forest vegetation. Growth of the savannah vegetation is largely attributable to the high increase in the rate of shifting cultivation and bush fallowing in the Municipality (MLGRD, 2006). The climatic conditions of the Municipality together with the topographical layout are favorable condition for the cultivation of food crops. Also the derived form of savannah vegetation at the northern part of the Municipality supports the cultivation of cereals.

### 3.1.2 Economic Activities

Economic activities in the Municipality are highly varied with agriculture production assuming the majority (about 68 percent of the populace are into primary agricultural production), with the rest into the service (about 24 percent) and industrial (about 8 percent) sectors. The agricultural activity serves as a main source of livelihood for most people in the Municipality. The agriculture sector of the Municipality includes both crop production and livestock rearing. Both activities are mostly subsistence in nature and it involves mostly the aged with land size between one to three acres for crop production and 10-30 animals (mostly poultry) for livestock rearing (GSS, 2014). Few people are into large-scale farming. Several types of crops are cultivated in the Municipality of which the prominent are maize, yam, beans, rice, plantain, cassava, cocoyam, pepper, tomatoes and garden-egg. However, crops such as maize, beans and watermelon are cultivated mainly for commercial purpose. The major cash crop cultivated in the Municipality is cocoa (GSS, 2014).

Aside the agricultural sector, the service sector is the second most developed sector in the Municipality in terms of economic activities (GSS, 2014). The type of services provided includes petty trading, hairdressing, tailoring, driving, communication services, clerical work and pharmaceutical services. Petty trading, hairdressing and tailoring outnumber the rest of the service activities in the Municipality.

The industrial sector in the Municipality is aimed at transforming raw materials into processed goods in order to add value to the produce, create employment and promote private sector competitiveness in the Municipality. The main type of industry are manufacturing and agro-based industries (GSS, 2014). The agro-based industry comprises palm oil production, palm wine

production, rice, corn and flour milling and mushroom cultivation. The manufacturing industries include saw milling, carpentry, masonry, bakery, pottery and blacksmithing.

## **3.2 Methodology**

### **3.2.1 Sources of Data**

According to Robson (2002), primary data contributes to the researcher's ability to address the most important issues in the research context, hence primary data was collected for this study. In order to gather reliable and valid data, the study employed two methodological approaches in which the qualitative approach was used to complement the quantitative approach. Data collected included farm-level and demographic information; respondents' perception on climate change, as well as climate change effects on their livelihoods. Data on institutions relevant to assisting farmers adapt to climate change was also collected. In all, the study interviewed men and women smallholder farmers, key informants, government representatives at community levels, Assembly Persons as well as Agricultural Extension Agents (AEAs).

In addition to the primary data, the study collected secondary data including a review of available literature and statistics on the topic areas, including reports and working documents prepared by government agencies and civic institution as well as other official publications. The secondary data analysis also involved archival research from books, journals, magazines, articles, internet materials and other related information.

### **3.2.2 Data Collection Method**

The selected method for primary data collection was done under the form of semi-structured and in-depth interviews by using a questionnaire. According to Saunders (2003), the use of interviews and questionnaires help to collect valid and reliable data relevant to the research

questions and objectives as well as provides first-hand and new information regarding the topic under study. Finally they encourage respondents to talk and go more deeply into the issue of concern.

In addition, two focus group discussions were conducted to solicit in-depth information from both male and female smallholder farmers concerning the effects of climate change on their livelihoods. This kind of research gives a more in-depth description and understanding of events or actions and this helps the researcher to gain insight into why and how events or actions take place rather than just presenting a phenomenon (Barbie and Mouton, 2007).

The study also employed the method of observation as part of the data collection method. The observation process involved looking and listening carefully in order to discover particular information about respondent's behavior (Merriam, 1998). Observation is central to qualitative data collection as it provides first-hand and new information regarding the topic under study. It also provides accurate and reliable data since method of collection is less influenced by externalities but dependent on the observer (Merriam, 1998).

### **3.2.3 Sampling Method**

A multistage sampling approach was employed in this study. Firstly, the purposive sampling was used to select Ejura/Sekyedumasi Municipal. In addition, two communities namely, Ejura Nkwanta and Frante were selected to form the scope of the study. These communities were purposively chosen based on their similar demographic characteristics such as population sizes, farm sizes, sources of livelihood and types of crops cultivated. According to Barbie and Mouton (2007) purposive sampling is a valuable kind of sampling used in exploratory research that gives the best chance to get rich qualitative data.

Secondly, a stratified random sampling method was used to separate female smallholders from their male counterpart. A gender-based stratum was justified in this study on the ground that, most women in the Municipality tended not to be heads of households, have smaller farm sizes as well as have limited access to resources such as inputs and extension services (USAID & MFCS, 2014). Hence if women were not purposively targeted, their number would be small and their opinions will not be given proper attention in this study.

Lastly the simple random sampling method was employed for collecting data from households. The simple random sampling method was used due to the homogeneity of farmers. Broadly, all the smallholder farmers face the same weather, have common livelihood assets, market and soil conditions. They also have similar socioeconomic characteristics. Hence this sampling approach provided the farmers equal chances of being part of the study (Saunders, 2003).

### 3.2.4 Sample Size

In the determination of sample size for the study, the formula:  $n = \frac{N}{(1+N)e^2}$

where  $n$  = sample size,  $N$  = population size (85,446 based on 2010 Population and Housing Census for the Municipal) and  $e$  = level of precision (0.05), when used would require a sample size of 400 but due to resource constraints (financial and time) 120 smallholder farmers were selected and interviewed. Out of these 120 respondents, 60 were selected from each community with men and women assuming equal proportions.

Only adults of 40 years and above were marked for selection because it is understood that farmers under 40 years would not be able to identify their experience of climate changes in the region, since climate change is a long-term shift in weather conditions identified by changes in temperature, precipitation, winds, and other weather indicators.

Also six institutions were interviewed. These comprised three public (COCOBOD, Forestry Commission and Ministry of Food and Agriculture), two private (Sefwiman and Sekyedumasi Rural Banks) and one civic institution (World Vision International, (WVI)).

### **3.2.5 Method of Data Analysis**

This section presents the various methods that the study used to analyse data on specific objectives.

#### **3.2.5.1 Measuring Perception of Smallholder Farmers' on Climate Change in the Municipality**

The first objective of the study sought to describe the perceptions of men and women smallholder farmers on climate change in Ejura/Sekyedumasi Municipal. In this study the Likert scale ranking was adopted to rank the perceptions of the farmers on climate change. Based on the statement such as; 'Weather conditions have changed over the last 10 years'. The responses was ranked as: 1= strongly agree, 2= do not know, 3= strongly disagree. This was followed up with questions such as, "How has temperature and rainfall change over the last decade. Answers provided included; increased, decreased, do not know and no change. Descriptive statistics in the form of mean, mode, median, graphs, percentages, pie chart was used to represent findings.

#### **3.2.5.2 Determining the Effects of Climate Change on the Livelihoods of Men and Women Smallholder Farmers**

This Objective was achieved by conducting an in-depth interview with men and women smallholder farmers by using a semi-structured questionnaire. In order to ensure accuracy and consistency in responses, focus group discussions were undertaken with men and women smallholder farmers in the study area on the differential impact of climate change on their

livelihoods. An interview guide was employed to assist in the discussion. Data gathered from such discussion was transcribed.

### Statement of Hypothesis

**Hypothesis 1 H<sub>0</sub>:** Climate change has no differential effect on the livelihoods of men and women smallholder farmers

**H<sub>A</sub>:** Climate change has differential effect on the livelihoods of men and women smallholder farmers

### Validation of Hypothesis

The Phi correlation test ( $\Phi$ ) stated as;  $\Phi = \frac{AD-BC}{\sqrt{(A+B)(C+D)(A+C)(B+D)}}$ , was used to determine if climate change has an effect on gendered livelihood.

Where;

$\Phi$  = Phi coefficient

**A and B**= number of men smallholder farmers whose livelihoods are affected by climate change or not respectively.

**D and C**= number of women smallholder farmers whose livelihoods are affected by climate change or not respectively.

In addition, the Chi-Square test, stated as  $X^2 = N \Phi^2$  was employed to test for significance in the effect of climate change on gendered livelihoods.

Where

$X^2$  = Chi Square Calculated

$N$ = Total number of men and women

$\Phi$  = Phi coefficient

The decision rule was to reject the Null Hypothesis ( $H_0$ ) in favor of the alternate ( $H_A$ ), if Chi-Square calculated is greater than the critical value, and vice versa.

### 3.2.5.3 Coping Strategies Employed by Smallholder Farmers in the Face of Climate

#### Change.

In order to fulfill this objective, various coping strategies were reviewed from literature and findings presented to the smallholder farmers affected by climate change shocks to choose and rank which strategies they employ to safeguard their livelihoods during climate change challenges and extreme weather events. The Kendall's coefficient of concordance ( $w$ ) was employed to better understand the magnitude in the ranking and the differences in the coping strategies adopted by the smallholder farmers.

The Kendall's coefficient of concordance ( $w$ ) ranges from zero (0) to one (1). It is 1 when the rank assigned by each farmer is exactly the same as those assigned by other farmers and it would be 0 when there is maximum disagreement among the farmers ranking of the coping strategies. The formula for the coefficient of concordance ( $w$ ) is given as:

$$W = \frac{12[\sum T^2 - (\sum T)^2 / n]}{nm^2(n^2 - 1)}$$

Where;

**T**= sum of ranks for each coping strategy

**m**= number of rankers (farmers)

**n**= number of coping strategies being ranked

### 3.2.5.3.1 Statement of Hypotheses and Significant Test

**H<sub>0</sub>:** There is no difference in the coping strategies that are employed by smallholder farmers to safeguard their livelihood during climate change

**H<sub>A</sub>:** There is a difference in the coping strategies that are employed by smallholder farmers to safeguard their livelihood during climate change

Where **H<sub>0</sub>** is the null hypothesis and the **H<sub>A</sub>** is the alternate hypothesis. Significance in agreements in the coping strategies was tested by the use of the chi-square test. This is stated as;

$$X^2 = \sum \frac{(O - E)^2}{E}$$

Where;

**X<sup>2</sup>** = Chi-square

**∑**= Sum of the above frequencies across all cells

**O**=Observed frequency

**E**= Expected frequency

### 3.2.5.4 Identifying the Role of Institution in Climate Change Adaptation

Local institutions that operate in the Municipality were identified by the help of farmers and categorize as public, civic and private organizations. These institutions were interviewed on climate change impacts as well as the various services they provide to help smallholders farmers address climate change challenge. Descriptive statistics was used to present the findings

### 3.2.6 Scopes and Limitation of the Study

It is important to consider the limitation of this study. Clearly, the scientific methods that this study employed are powerful research tools, but they have limitation associated with this work.

This study was conducted based on the assumption that the sampled smallholder farmers were a fair representation of all farmers in the Municipal due to the fact that they are homogenous in characteristics either in cultural or socio-economic. This assumption might not be true for the rest of the farmers in the municipal. Also, majority of the farmers interviewed do not keep farm records, hence they only try to remember information from their memories, and the assumption that they remembered and gave accurate information is not entirely true,



## CHAPTER FOUR

### RESULTS AND DISCUSSION I

#### 4.0 Introduction

This chapter presents the results of analysis of data gathered during the study. The first part of the chapter covers the sample distribution as well as the socio-economic characteristics of the smallholder farmers in the Ejura/Sekyedumasi Municipal. The second part describes their perceptions on climate change and compares it with empirical data. Also the results on the impacts of climate change on the livelihoods of men and women smallholder farmers are also presented in this chapter.

#### 4.1. Sample Distribution among the Communities

Table 4.1 summarizes the actual sample sizes from the various communities. From the field, equal numbers of men and women smallholder farmers were sampled from the two communities respectively, totaling up to 120 respondents.

**Table 4.1. Sample Distribution among Communities**

Community	Sex		Total
	Male	Female	
Ejura Nkwanta	30	30	60
Frante	30	30	60
<b>Total</b>	<b>60</b>	<b>60</b>	<b>120</b>

#### 4.2. Socio-economic Characteristics of the Sampled Households

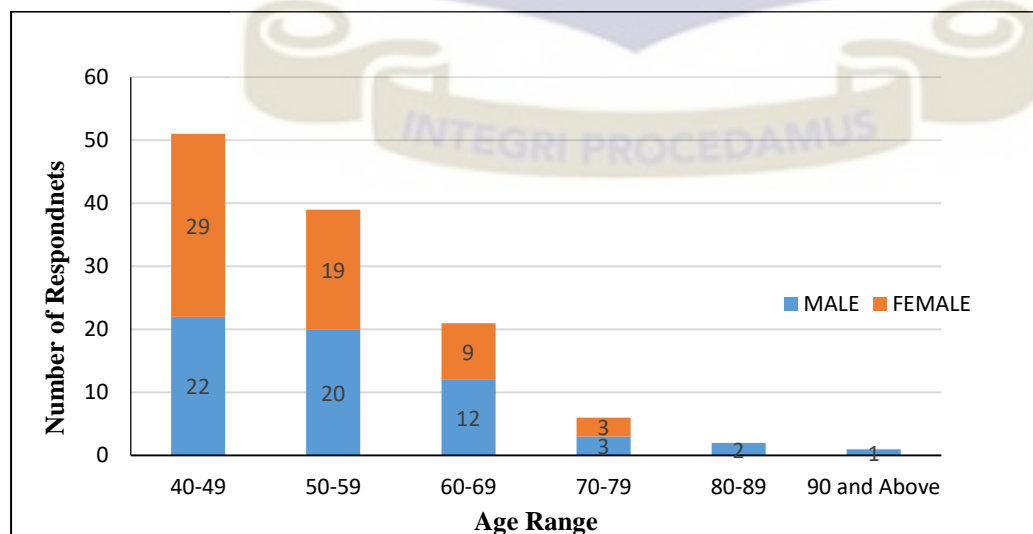
This section used descriptive statistics such frequency tables, bar and pie charts to describe the age, gender, educational status, marital status, religion, household size, and origin among many.

#### 4.2.1. Age Distribution and Sex of Respondents

Both age and sex have a major influence on the way people perceive things and respond to situations due to biological and psychological differences (Phuong, 2012). Therefore it is very helpful to thus categorize respondents in order to be able to obtain a variety of feedback from both men and women based on their individual experiences, observations, and opinions.

The youngest respondent was 40 years old while the oldest was 90 years old. The age groups of 50-59 years and 60-69 years represented 32 percent and 17 percent of the total respondents respectively. As shown in figure 4.2.1, the age group 40-49 accounted for the majority (42 percent) of the total respondents and more than half were women smallholder farmers. In other words, there were more middle-age women than other age groups interviewed during the survey. This implies that the main labor forces in the study area were women aged between 40-49 years. The result of this study confirms the findings of Phuong (2012) and Crentsil (2013) whose studies in Vietnam and northern Ghana concluded that; the main labor force in agriculture is women and children.

**Figure 4.2.1: Age Distribution and Sex of Respondents**

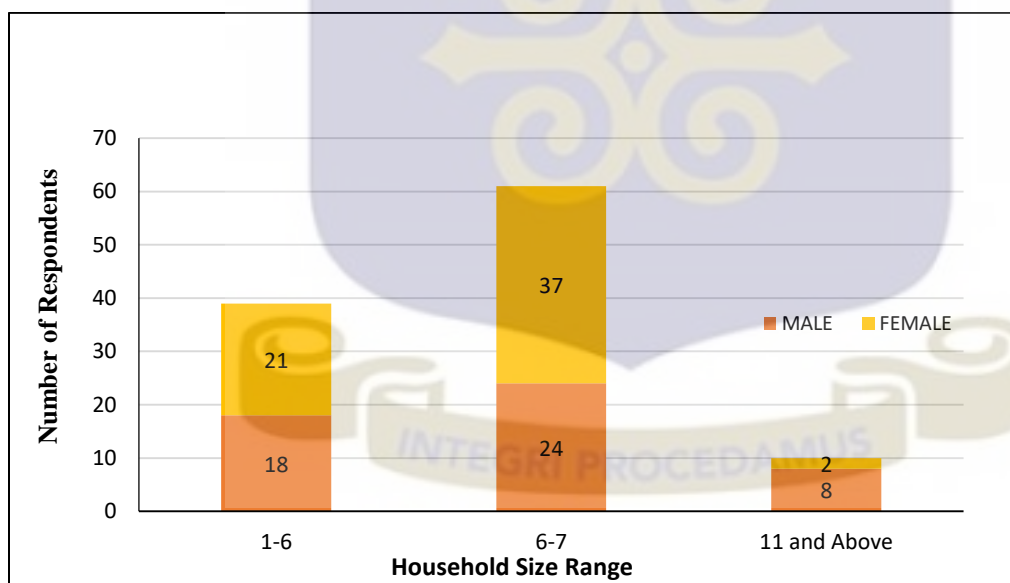


(Source: computation from field data, 2015)

#### 4.2.2. Household Size of Respondents

The term “household” is the basic residential unit that normally includes all individual living in the same dwelling (Sullivan & Stevens., 2003). Household size and composition generally implies some socio-economic factors such as gender, income, education, and occupation (Phuong, 2012). It is argued that household size and composition is a determinant factor for the capabilities, choices, and coping strategies available to its members (Rakodi, 2002). Therefore, understanding the household size and its composition of the survey respondents is important in this study in terms of relationships between the smallholder farmers, their family members and the livelihood assets that they have access to in order to build new livelihoods or sustain existing ones.

**Figure 4.2.2: Household Size of Respondents**



(Source: computation from field data, 2015)

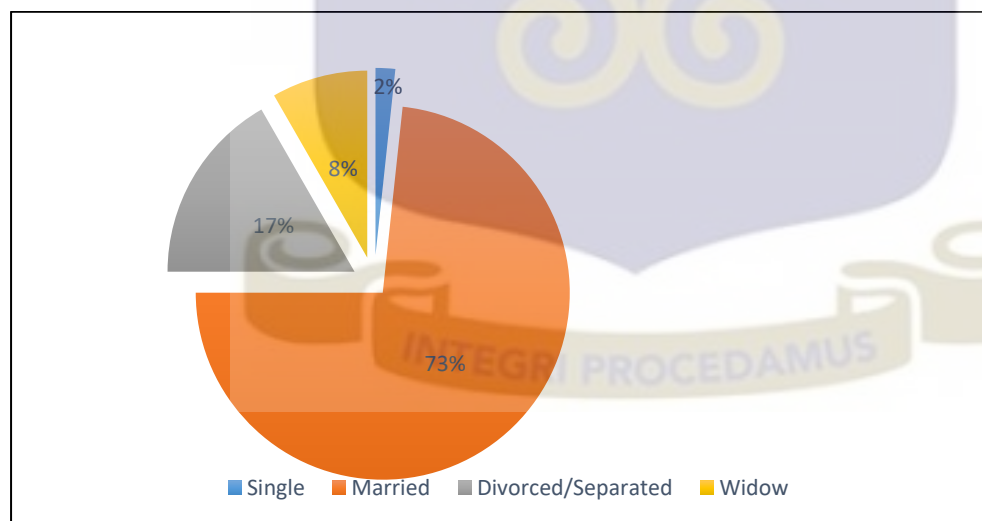
From figure 4.2.2, it is clear that households of 6-10 members were the largest group, comprising 63.3 percent of the total respondents' households with female-headed households assuming the majority (38 percent). There were only 4.2 percent of households with 11 or more members

whilst the households with 1-5 members were made up of 32.5 percent. This results implies that, female headed households are likely to have more labor force to support agricultural and non-agricultural activities nonetheless they have more dependents than their male counterparts. Hence in the face of extreme weather events, female-headed households are more likely to be adversely affected. The findings of this study contradicts the work of USAID and MFCS (2014) who argue that the male headed households tends to have more members and labor force than their female counterparts.

#### 4.2.3. Marital Status of Respondents

Out of the one hundred and twenty respondents, eighty-eight (88), representing about 73 percent were married. About 17 percent were divorced/separated, while the respective percentage of respondents who were widowed or single assumed 8 percent and 2 percent see Figure 4.2.3.

**Figure 4.2.3: Marital Status of Respondents**



(Source: Computation from field data, 2015)

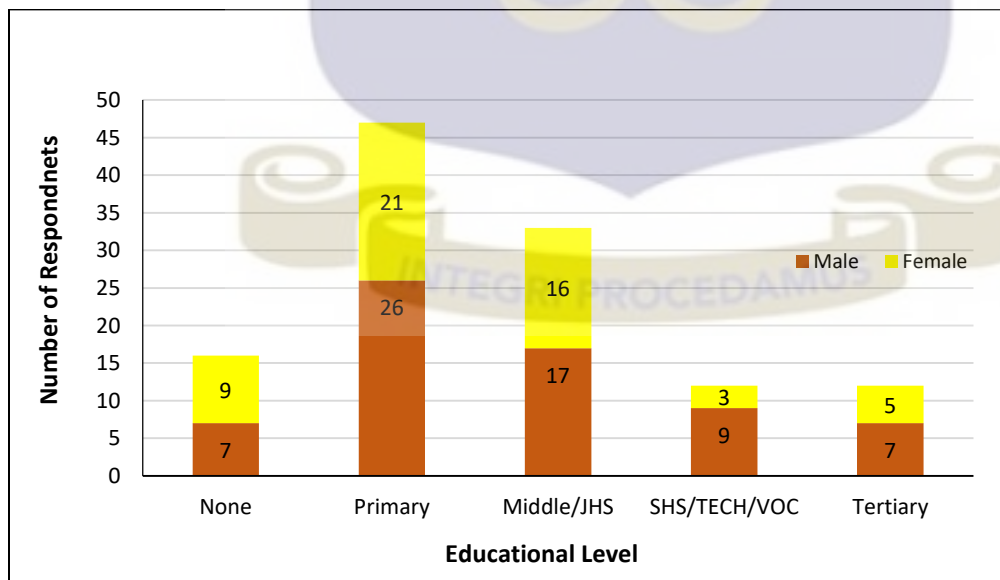
The implication of the result is that, married farmers, being the dominant group of farmers in the survey, are more likely to withstand climatic shocks than the other groups because these group of

farmers can combine efficiently and provide resources (financial and human resource) to design appropriate coping strategies for themselves and family members (Lopez, 2008).

#### 4.2.4. Educational Level of Respondents

According to Maddison (2007), the number of years of education of smallholder farmers is a major determinant that shapes how they perceive their environment including a changing climate. From figure 4.2.4, 26 male respondents representing 55 per cent have primary education while 21 females did (45 per cent). Similarly 75 per cent of men smallholder farmers enrolled in Senior High School (SHS)/ Technical/ Vocational school but only 25 per cent of the women did. For those who had no education (formal/non-formal), majority were women smallholder farmers (56 per cent). The above result implies that more men smallholder farmers are likely to perceive changes in climate than the women smallholder farmers. This study confirms that of Maddison (2007) and Phuong (2012).

**Figure 4.2.4: Educational Levels of Respondents**



(Source: Computation from field data, 2015)

#### 4.2.5. Farming Experience of Respondents

According to Deressa (2008), it is well-experienced farmers who perceived that climate has changed. Therefore it is convenient for a researcher to look at the perception of farmers on climate change based on the respondents' years of farming experience (Maddison, 2007). The results presented in Table 4.2.5 shows that 48 men smallholder farmers representing 53 percent and 42 women smallholder farmers (47 percent) had 11-21 years of farming experience. Similarly, 70 percent of men and 30 percent women smallholder farmers had 1-10 years farming experience. From the study it is evident that men smallholder farmers have more farming experience than their women counterparts. This implies that men smallholder farmers are likely to perceive changes in climate than the women smallholder farmers (Deressa., 2008; Maddison, 2007),

**Table 4.2 Farming Experience of Respondents**

<b>Sex</b>	1-10	11-21	Above 21	<b>Total</b>
Male	7	48	15	60
Female	3	42	5	60
<b>Total</b>	10	90	20	120

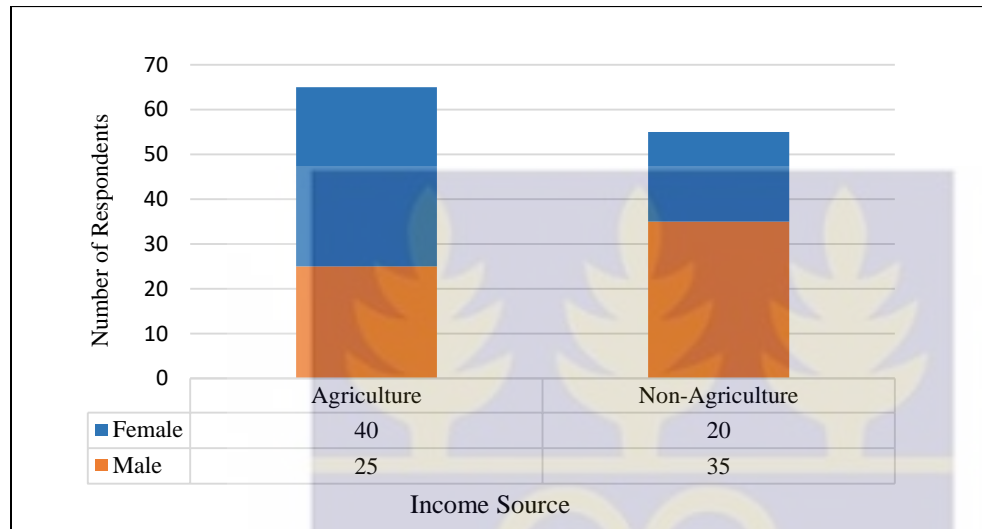
(Source: Computation from field data, 2015)

#### 4.2.6. Sources of Income for Respondents

Figure 4.2.6 highlights the sources of income for the smallholder farmers in the study area. Among the smallholder farmers, 40 female respondents representing 62 percent derived their income from agricultural activities such as primary crop production and/or animal rearing; working as laborers on people's farm, trading in agricultural commodities; as well as processing of agricultural produce whilst that of the male respondents represents 38 percent. Aside the agricultural production providing income for some respondents, non-agricultural activities such

as trading in non-agricultural commodities and working in non-agricultural sectors also provide income for 64 percent and 36 percent of the male and female smallholder farmers respectively.

**Figure 4.2.6: Sources of Income for Respondents**



(Source: Computation from field data, 2015)

The implication of this result is that, majority of the female smallholder farmers stand the risk of losing their livelihoods from the agricultural sector, mostly from primary production, in the face of a changing climate than their male counterparts. The results of this study is consistent with the work Fosu-Mensah *et al.* (2012) and Sagoe (2006) who posited that female farmers stand the risk of losing their livelihoods from the agricultural sector in the face of a changing climate due to the fact that they are mostly involve in food production with inadequate inputs and resources.

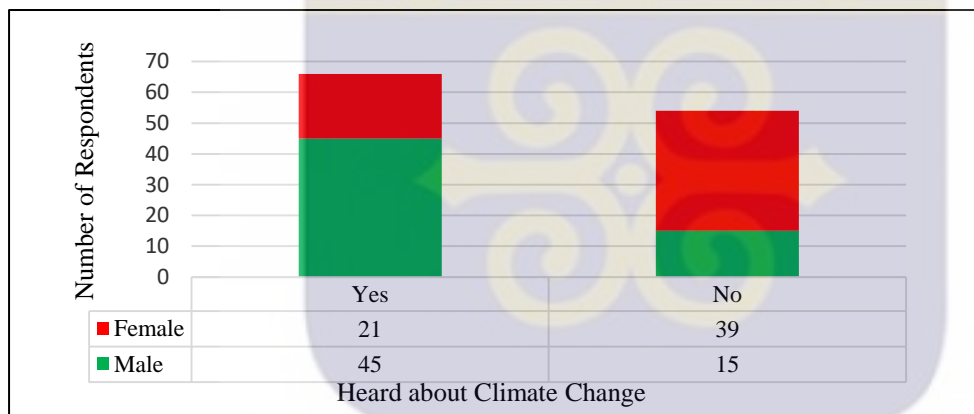
### 4.3. Perception of Smallholder Farmers of Climate Change

The study assessed smallholders’ perception of changes in climate variable (mainly rainfall, temperature and extreme events) over the past 5-10 years. Household survey results shows that a total of 66 respondents representing 55 percent had heard about the term “climate change”, mainly through television, agricultural extension agents, radios and loudspeakers. However many

could not explain what climate change was, therefore there was need to explain this in other words.

It appeared that more men smallholder farmers knew about climate change than women. Among those who had heard about climate change, 45 were male smallholder farmers representing 68 percent whereas 32 percent were females (see Figure 4.3.1). This findings is in line with finding of Dube and Phiri (2013), Fosu-Mensah *et al.* (2012) and Phuong (2012) who argue that male farmers are more informed about climate change happening because they have ready access to information due to their frequent participation in training and educational programs.

**Figure 4.3.1: Men and Women Smallholder Farmers Heard about Climate Change**

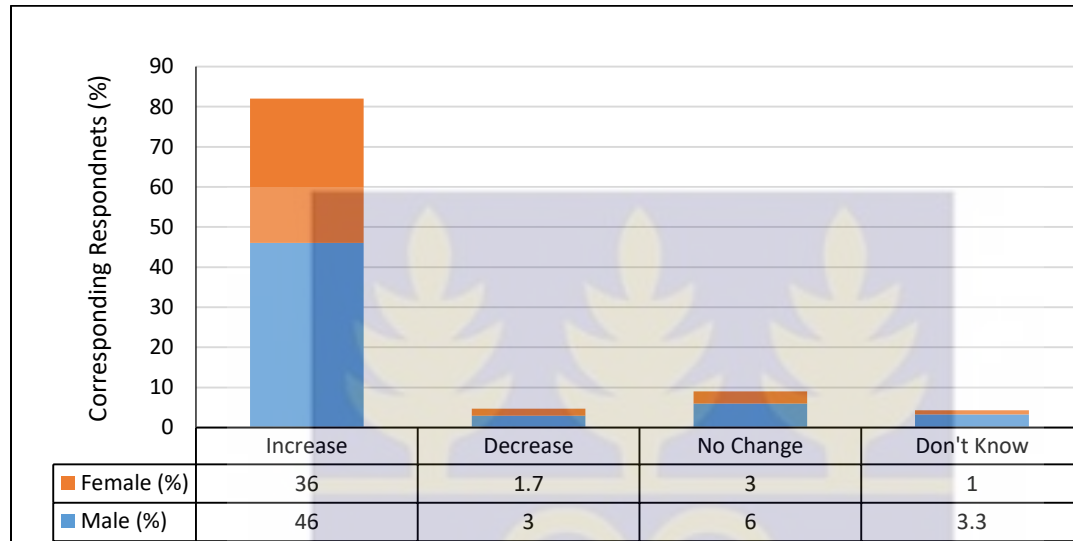


(Source: Computation from field data, 2015)

Furthermore, for changes in temperature, a total of 82 percent, consisting of 46 percent males and 36 percent females, perceived an increase in average temperatures while only 4.7 percent (3 percent males and 1.7 percent females) perceived a decrease. A total of 13.3 percent gave other responses (see Figure 4.3.2). As to the causes of perceived rise in temperature, about 54.2 percent (consisting of 38 percent males and 14.2 percent females) attributed it to deforestation; 25.8 percent (18 percent males and 7.8 percent females) to bush burning; 11.5 percent (9 percent

males and 2.5 percent females) to increase in population and 3.5 percent to punishment from deity for disobeying cultural norms/values.

**Figure 4.3.2: Farmers Perception of Change in Temperature**



(Source: Computation from field data, 2015)

The remaining 5 percent of the respondents could not give any reason for the perceived change in temperature. The findings of the study is consistence with Fosu-Mensah *et al.* (2012) who asserted that smallholder farmers attributed changes to temperature to mostly deforestation and bush burning.

Both respondents in the household questionnaires and participants in the focus group discussions unanimously agreed that a broad range of climatic and ecological changes had happened in both Ejura-Nkwanta and Frante over the period that they have known the place. Participants noted that these changes hinged around increasing temperatures and falling rainfall levels. In the view of focus group discussion participants from the two communities perceived temperature levels had dramatically increased in recent years. One woman stated in a focus group discussion (FGD 1) that;

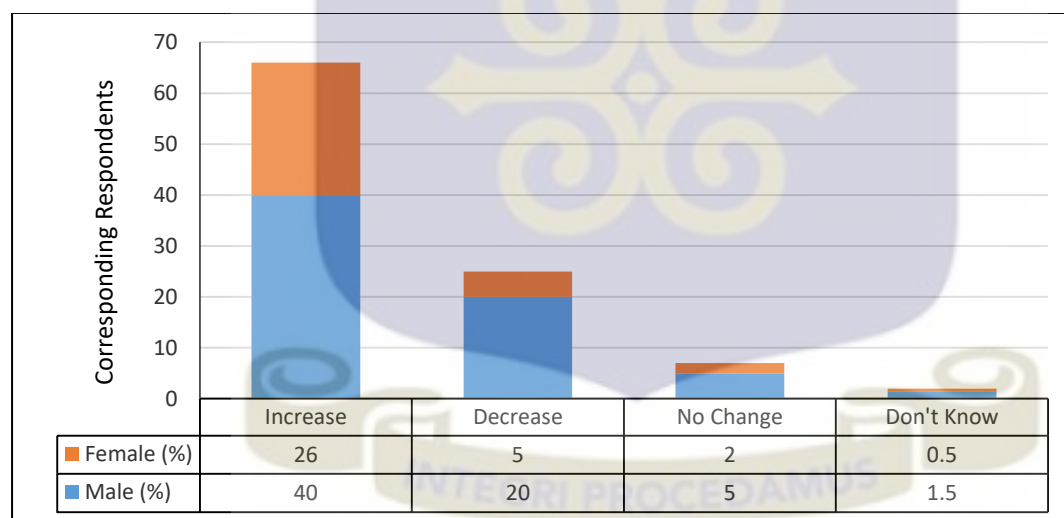
“Since I was born in 1945, I have never experienced such hot temperatures that burns like fire. And concerning farming, I have a very good piece of land such that even when others were getting nothing but I would normally get something but now, it has been many years since that wetland dried up” (FDG 1).

Another participant (male) in a different focus group discussion lamented that:

“It seems that the sun has moved its position closer to the earth judging from the way it is hot and this is making farming unbearable in the community” (FDG 2).

On rainfall, perception results (Figure 4.3.3) indicated that about 92 percent of the smallholder farmers reported observing changes in rainfall amount and pattern.

**Figure 4.3.3: Farmers Perception of Change in Rainfall**



(Source: Computation from field data, 2015)

Most of the respondents, 66 percent constituting 40 percent males and 26 females percent, indicated that most observed and perceived pattern was that precipitation showed a decreasing amount and increased variability trend. Only 25 percent consisting of 20 percent male and 5 percent female smallholder farmers perceived an increased in rainfall.

The focus group participants and respondents in the household survey were unanimous in the observation that rainfall patterns had changed in the study area. Two main changes were noted. Firstly, smallholder farmers observed that the amount of rainfall had decreased notably. Secondly, they observed that rainfall patterns had become unpredictable and the seasons had changed. Regarding rainfall amount, a male participant said that;

*“In the years gone by, in the month of April, rivers, streams and ponds would be full and you would not be able to cross them, especially rivers. The ground would be green with grass, but now in April and sometimes in May, it is unreasonably hot and this results in drying up of these water bodies creating water shortage in the community as well as destruction of crops” (FDG 1).*

Concerning the changes in rainfall pattern, another male participant reported that;

*“The main rainy season which used to be between late April and early November has now shifted to late May and late August and this continue to vary. As a result, even if we want to plant, it is now difficult to know how to plant, when to plant and what to plant” (FDG, 1).*

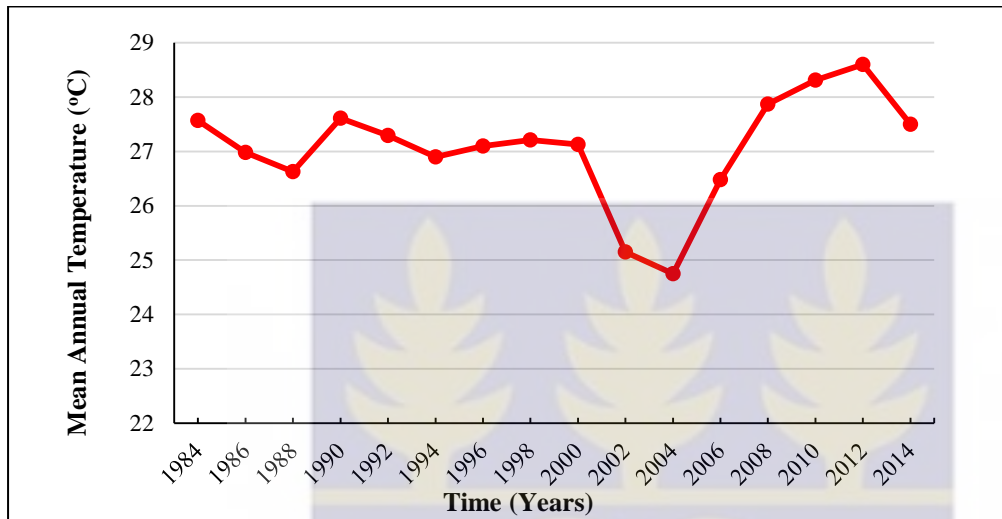
As to the perceived cause of the change in rainfall, 63 percent and 30 percent of male and female smallholder farmers attributed it to deforestation and bush burning while the remaining 7 percent could not give any reason for the perceived change.

#### **4.3.1. Comparing Smallholder Farmers Perceptions and Empirical Climate Change Evidence**

To verify farmers perceived long-term change in temperature and rainfall, the historical mean annual temperature and rainfall data in Ejura from 1984 to 2014 were analyzed. The data shows a slight increasing trend in temperature especially from 2004 to 2012 and this was in agreement with what was perceived by the farmers (see Figure 4.3.4).

**Figure 4.3.4: Historical Mean Annual Temperature in Ejura/Sekyedumasi Municipal**

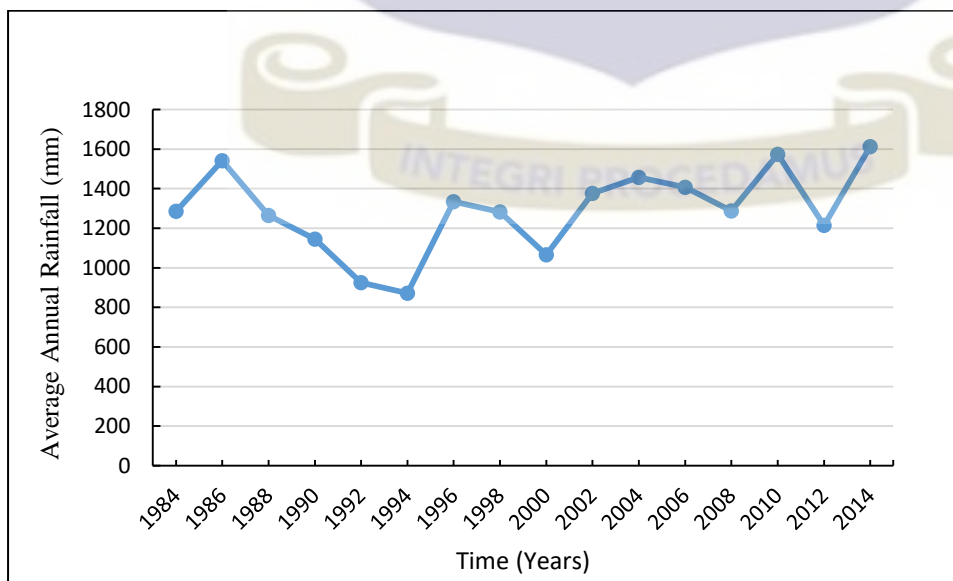
*(Source: Author's Computation based on GMA data, 2015)*



*(Source: Author's Computation based on GMA data, 2015)*

For rainfall, the amount declined at an increasing rate from 1986 to 1994 (1541.8mm to 871.9mm) but increased at a decreasing rate from 2000 to 2006 (1065.7mm to 1470.7mm) (see Figure 4.3.5).

**Figure 4.3.5: Historical Average Annual Rainfall in Ejura/Sekyedumasi Municipal**



*(Source: Author's Computation based on GMA data, 2015)*

The climate data on rainfall were in perfect agreement with perception results on rainfall. These results imply that farmers can accurately perceive changes in climatic variables and consistent with the finding of Fosu-Mensah *et al.* (2012).

#### **4.4. Effects of Climate Change on the Livelihoods of Men and Women Smallholder**

##### **Farmers**

Smallholder farmers in Ejura-Nkwant and Frante communities reported having noticed changes in climate. The communities perceived that these changes contributed to adverse effects on their livelihood sources, which are mainly agricultural-based and also based on non-agricultural activities. According to Chambers and Conway (1992) and DFID (1999), livelihoods are primarily built on assets/capital, capabilities, and activities. Hence any obstruction to these livelihood components, especially assets, is bound to adversely affect the attainment of livelihoods (DFID, 1999).

Also these assets/capital types are important in this study since they form the foundation for building rural livelihoods hence any impact (be it shocks from climate change) on them is likely to adversely influence the attainment of men and women stallholders' livelihoods.

The following sub-sections summarize climate change effects on the different types of assets/capital upon which men and women smallholder farmers draw to build their livelihoods. Following the gender and climate change analytical framework, these assets/capital includes: natural capital, human capital, physical capital, social capital, and financial capital.

##### **4.4.1. Climate Change Effect on Natural Capital**

According to DFID (2000), natural capital refers to the natural resource stocks from which resource flows and services (e.g. nutrient cycling, erosion protection, waste assimilation) useful for livelihoods are derived. There is a wide variation in the resources that make up natural

capital, from intangible public goods such as the atmosphere and biodiversity to divisible assets used directly for production such as trees, land, forest, etc. Natural capital such as land, forest, water bodies are very important to the rural populace since they derive all or part of their livelihoods from resource based activities such as farming, fishing and gathering in the forest (Nicole, 2000). However, the relationship between the natural capital and climate change are so close that such shocks devastate the livelihoods of the rural poor who largely depend on climate sensitive sectors, such as agriculture (DFID, 2000 and Phuong, 2012). The study tried to analyze the effect of climate change on natural capital by taking into account the effect of the former on land, forest and water bodies.

From the study, it was revealed that more men (about 83 per cent) own land compared to their female counterparts (only 17 per cent). Women in the Municipality only own land through inheritance from the death of their husbands or parents. Comparing land sizes, those of the women smallholder farmers are relatively fragmented and smaller. To add, their use and control of this inherited land is sometimes restricted to the types of crops to be cultivated. This condition limits their agricultural production and the attainment of household food security since they are responsible for food at the household level.

Event of drought, floods and extreme weather events has had a significant effect on women than on men in the Municipality. This confirms the report of IPCC (2007) and BRIDGE (2008) that states that, “the impacts of climate change would be much felt by women, since they are vulnerable and highly marginalized in the society”. Some of the direct effects according to the research participants were caused by floods and high temperatures, which ultimately affected crop production and animal rearing as well as general agricultural livelihood development in the Municipality. From the FGD, participants highlighted the serious negative effects climate change

had caused on their natural capital. It included, degradation of arable lands for agricultural production through high temperatures and floods as well as destruction of crops and livestock.

*“The recent high temperatures in the community have brought about wilting of my tomatoes, pepper and maize crops. As if that was not enough this was followed by a windstorm, killing 14 of my chickens and this has resulted in loss of income” (Female participant 1, Extract from FDG 2).*

*“For the past decade, my farmland has never been flooded no matter the amount of rainfall, but for some time now, it easily get flooded with the least rainfall to the point that the rains washes off my crop and erodes my land” (Female participant 2, Extract from FDG 2).*

Similarly, a male participant also stated that;

*“I have to recently create gutters in my farm to carry away rain water in the events of floods just to prevent excessive erosion from happening” (FGD 2).*

As mention earlier, the forest provided services such as nutrient cycling, erosion protection, waste assimilation and others for livelihoods development. It also served as habitat for most animals (such as antelopes, grass cutters, bats and rodents) and also contained trees and grasses for food, pasture, medicine and economic benefits. The incidence of bushfires triggered by high temperatures had led to destruction and migration of wild life and decreased biodiversity in terms of plants and animals in the Municipality. This condition has further resulted in rural income loss since most smallholder farmers apart from crop production; engage in hunting of animals and collection of woods and twigs for sale as fuel wood or building materials. The women smallholder farmers were the most affected during this situation due to the fact that much time

and effort are spent in the search for wild fruits and medicinal plants for household consumption. The following were extracts from focus group discussions organized during the study;

*“I have been staying in this town for the past 55 years, when I was young, say 7-9 years, I could easily see the likes of rodents, squirrels and grass cutters feeding around the backyard of my home, but due to the recent harsh nature of the climate which are erratic rainfall and high temperatures, these animals can no longer be seen even if one goes into the thickest forest”*  
(Extract from a Male participant during FGD 1).

*“Collection of snails, fire woods, twigs and medicinal plants was done occasionally by me and my children in the past any time we lack any of them for household consumption but due to the recent rate of forest degradation by high temperatures and floods, we collect them any time we go to the farm and even that, we have to walk for longer distances and this leaves us little time to do domestic work”* (Extract from a Female participant during FGD 2).

Drying up of water bodies including community wells, boreholes, rivers, and streams were very evident in the study area. Many households in the study area found access to fresh water sources a major challenge during the time of the study. Many women smallholder farmers and children were seen travelling longer distances just to obtain safe and portable water for household consumption. Others who could not go that far, resorted to using alum to purified brown-coloured water that had been fetched nearby purposively for washing and cleaning but used rainwater for cooking. Women and children were responsible for collecting water for household use as this was considered as a domestic job. However, this task had become more difficult and stressful during hot dry season and erratic rainfall.

*“Most of the well and boreholes have dried up in the community and the rains also do not come. This has resulted in most of us going as far as to the next community, which is about 3 miles away, to fetch water. The situation is really stressful and hampering on my health”* (Extract from a Female participant during FGD 2).

In addition to the above assertions, an officer from the Municipal Agricultural Unit (MoFA), noted that;

*“Agricultural production in the Municipality had decreased about 45 per cent from 2008 to 2014 as a result of large acreage of agricultural lands left to fallow due to drought and increase in floods”. The situation has resulted in drastic loss in income and increased migration of able-bodied people, especially men (about 70 per cent and only 30 per cent of women), from the rural areas into towns and cities for menial jobs”.*

#### **4.4.2. Climate Change Effect on Physical Capital**

Physical capital according DFID (2000) comprises the basic infrastructure and producer goods needed to support livelihoods, such as affordable transport; secure shelter and buildings; adequate water supply and sanitation; clean, affordable energy; and access to information. IPCC (2001) states that, “impacts of climate change would not only be limited to agriculture and food security, but extends to the destruction of basic infrastructure such as shelter and buildings, water supply and sanitation and communication forcing migration”. Thus climate change impacts on physical capital cannot be overlooked. Climate change effects on shelter and public infrastructure such as roads and market; productive tools and equipment; as well as electricity supply were at the forefront of this study.

With regards to climate change effect on the physical capital of men and women smallholder farmers in the Municipality, losses and damages of production tools and equipment caused by drought and floods were significant. These tools and equipment often belonged to both men and women in a household, so it means both were sustaining a loss. From the FDGs, both men and women from the two communities complained floods and windstorms occurring in the Municipality for the past one decade had destroyed personal assets.

*“My house was built in 2001 with cement block and roofed with aluminium sheets, it has withstood several changes in weather but the current windstorms happening in the community has ripped off almost all of my roofing. In addition, heavy rains eroded the foundation of my building to the point that I needed to fix sandbags to prevent further erosion”* (Extract from a male participant from FGD 1).

According to other participants from the FDGs, not only did climate change destroyed personal building but also public infrastructure such as roads and electricity supply. According to a female participant;

*“In April 2010, series of rainfall that occurred pulled down about 8 out of 20 electricity poles, interrupting electricity supply and causing 2 weeks of total darkness in Frante community. This situation resulted in halting most agricultural processing activities as well as non-agricultural activities in the community”* (Extract from FDG 2).

Further, for infrastructure such as roads and market centres, more female respondents (about 70 per cent) complained that;

*“For the past 5 years any time the rains come, the roads becomes muddy and inaccessible making it difficult to transport farm produce to the market centre. And even if one is able to*

*commute to the market centre, the market place becomes flooded, muddy and most of the time with some sheds destroyed deterring consumers from purchasing their produce. This situation results in making huge losses and in the worse cases, loss of livelihoods”* (Extract from FGD 2)

#### **4.4.3 Climate Change Effect on Human Capital**

Human capital is defined as “the skills, knowledge, ability to labour and good health that together enable people to pursue different livelihood strategies and achieve their livelihood objectives” (DFID, 2000; Smith and Skinner, 1982). It also includes, competencies, and attributes embodied in people that facilitate creation of personal, social and economic well-beings as well as motivation, behaviour, physical and emotional attributes and mental health (OECD, 2001; Sen, 1997). According to WHO (2008), human capital mostly human health (physical, psychological and emotional) would greatly be compromised during periods of extreme weather events such as drought and floods hence the need for remedial measures. Variables measured under human capital in this study include the physical, psychological and emotional aspect of human health.

The study recorded more female respondents (about 65 per cent) being worried about the effect of droughts and floods than men (about 35 per cent), in terms of health and safety due to the reproductive role assigned to them by society. According to the women participants, they directly take care of family members and did all the housework including collection of water, fuel wood and preparation of household food as well as doing farm work. As a result, their physical safety is highly compromised during and after periods of droughts or floods, since they become weaker during such events as they tended to work more but eat less than their husband and children.

*“I am responsible for collecting water, fuel wood, cooking as well as taking care of the children. All these tasks are very tiring but they have become more burdensome in this period of high temperatures and low rainfall. I have to travel longer distance to look for water for the*

*household, after that cook and sometimes prepare the children for school. As if that is not enough for the day, I have to move to the farm to work there too. This leaves me no time to rest and as a result I have been suffering from a chronic waist, neck and knee pains for sometimes now” (Female participant from FGD 2).*

From the study, it was accounted that, more women smallholder farmers (13 out of 15) faced the outbreak of malaria and water-borne diseases such as cholera, intestinal worms and typhoid, than men (5 out of 15) particular following exceptionally wet periods which resulted in contaminating water supply system in the Municipality. This results is consistent with the report of WHO (2011) who asserted that, women are more vulnerable to water-borne diseases in the face of climate change than men, since they are obliged by society to provide water at the household level.

Generally, the female respondents considered that their reliance on domestic and subsistence production coupled with existing climate change stresses (droughts and floods) on health and limited financial, institutional and human resources leave them more at the disadvantage side. Also according to the male informants, they were also equally worried about these issues as much as their female counterparts did, but complained most of them were often absent from home to cities in order to secure a livelihood so they could not do much more to relieve the concerns of their wives.

There were also some common sicknesses among men and women that tended to affect their health and livelihoods. They included headache, waist and back pain and irritability. Both male and female smallholder farmers complained that they had to work for long hours under the hot and direct sunshine and they thought this was linked to their illness.

All respondents in both communities complained that they would often times quarrel with their wives or husbands regarding the loss in agricultural production and changes in climate. Some women mentioned that, their husbands would start to drink when they loose their income and livelihoods due to the changing climate and would sometimes lose their tempers.

*“My husband cultivates a 5 acre of land for the past 20 years. He normally cultivates food crops such as maize, cassava, cocoyam and plantain on 1.5 acre for home consumption and grows cocoa on the rest for sale. He normally harvests 10-12 bags (64kg) of cocoa. Due to extreme weather events, which includes high temperatures and erratic rainfall in recent times, his yields especially cocoa has reduced drastically to 6-8 bags. This condition has made him to be drinking heavily just to while away the loss in yield and income. Sometimes, he would lose his temper and quarrel with me for no apparent reason”* (Female participant from FGD 2).

In contrast, some men said that, their wives too often complain about the work and how cost of many consumer goods has risen, which sometimes made them more annoyed.

*“My wife is responsible for cultivating the food crops which we use at home, she has been doing this for the past 13 years without complaining. I was surprised when she came to me complaining that the farm work has now become more tedious due to the high temperatures. Not only that, she also demanded an increased in the house keeping money and that made me angry. Her reason was that her farm could not supply the food stuffs adequate for household consumption”* (Male participant from FGD 1).

However, no respondents mentioned any forms of family violence, i.e. between husband and wife

#### **4.4.4. Climate Change Effect on Social Capital**

Social capital refers to social resources upon which people draw in pursuit of their livelihood objectives and are developed through “networks and connectedness” (DFID, 2000). It also provides a buffer that helps them cope with shocks such as climate change and act as informal safety net to ensure survival periods of extreme weather events. These increase people’s trust and their ability to act collectively (Woolcock and Narayan, 2000). According to Adger (2001), climate change impacts is likely to distort social capital of the rural poor by forcing migration and sometimes death leading to breaking up of groups and associations that promotes livelihood development. Social capital variables under consideration included network, connectedness and associations.

All the respondents took part in at least one social organization or networking (such as wedding or funeral ceremony). Nevertheless, more men, about 75 per cent (45 per cent in Frante and 30 per cent in Ejura-Nkwanta) participate in activities with more frequency than women, only 25 per cent (15 per cent in Frante and 10 per cent in Ejura-Nkwanta), especially in training courses related to farm management, bush burning and prevention of storms and floods. Also, there were many more men (65 per cent) than women (35 per cent) in saving group for disasters, a group established by the Ejura-Nkwanta community members to help its members and families to cope with natural disasters and strengthen the community-based disaster preparedness by giving the people the opportunity to prepare and build up reserves. Furthermore, these males mostly attended social activities such as festivals, funerals and wedding ceremonies. Also men were the main staff of the political and management structures in both communities. Only the Farmer Based Organization (FBO) in Frante community had a female leader.

Women participants attributed their low percentage to the less time they have after performing heavy household workloads which includes, taking care of all family members and at the same time conduct most of the subsistence tasks such as cooking, washing and water collecting. These conditions were likely to be exacerbated by natural disasters (such droughts and floods) and women's percentage is likely to reduce further if such events continue in the Municipality since they are the first point of call for care administration and food during and after the events (Phuong, 2012; WHO, 2012).

*“Because of our roles as women, we do a lot of domestic work leaving us no time to participate in community meetings and other social gathering that can help build us up. Even if we manage to participate in such meetings, we are in a rush to get back home and continue with domestic work. I was once in a community meeting when the clouds started forming, immediately my husband sent for me to come home and harvest rainwater. I was very annoyed but there was nothing I could do than exit the meeting prematurely”* (Extract from a Female key informant).

The increased percentage of men in these organizations and functions might also indicate the dominant trend in representation of men at the communities' process of consultation and decision-making (Phuong, 2012; Nhemachena *et al.*, 2014).

#### **4.4.5. Climate Change Effect on Financial Capital**

Financial capital refers to financial resources that people use to achieve their livelihood objectives (DFID, 2000). However, it has been adopted to try to capture an important livelihood building block, namely the availability of cash or equivalent, which enables people to adopt different livelihood strategies (Kollmair & Gamper, 2002). According to Bebbington (1999) extreme weather events such as droughts, high temperatures and erratic rainfall would greatly deplete the financial resources of the rural poor who heavily depend on agriculture, a climate

sensitive sector, for their livelihoods by destroying crop and animal resulting in decrease in yield, hence loss in income and forcing migration leading to loss of income earning opportunities. Financial capital variables under considerations in the analysis during extreme weather events included available stocks such as crop and livestock and regular inflow of money, which included income-earning opportunities.

The difficulty in agricultural production and income loss from both agricultural and non-agricultural sources caused by climate change and extreme weather events has forced many people in the Municipality to migrate to the cities to make extra-income for the family. In Ejura-Nkwanta and Frante, about 60 per cent and 75 per cent of families had at least one member working in the city as hired labour respectively. Also, about 85 per cent of men had more opportunity to migrate far from home than women did (only 15 per cent), as the women had to care for the home and children. Nonetheless, women migrate to find work, but only in local vicinity.

According to the women participants, most men send home as much money as they can, but visited home only two or three times a year mostly for traditional festivities or New Year holidays mostly in January or during emergency. For those women whose husbands or family member do not send home money periodically resort to borrowing money and sometimes food-stuffs from friends or relatives leaving them indebted for a long time, sometimes creating quarrels and tensions between the lender and borrower. A female research participant narrated how her lender humiliated her due to her inability to settle her loan on time.

*“My husband is a farmer but due to bad weather conditions which caused wilting of his maize crops in 2010, he had to migrate to the neighbouring town to look for menial jobs. After 5*

months of being away seeking for job, I had to resort to borrowing of foodstuffs and sometimes money because I had exhausted my reserves. I was of the hope that he would soon send me money to settle my debt but that did not happened. This resulted in my debtors calling me names and quarrels due to my inability to payback” (Extract from FGD in Frante community). This result confirms the study conducted in Vietnam by Phuong (2012).

#### 4.4.6. Correlation Result of Climate Change Effect on Gendered Livelihoods

The Statistical Package for Social Science (SPSS) version 18 was used to run Phi correlation on climate change effect on livelihoods of men and women smallholder farmers in the Ejura/Sekyedumasi municipal. The variables ‘Climate change effect on livelihoods’ and ‘Sex’ were binary in nature (assuming ‘1’ if climate change has affected ones livelihood and ‘0’ for otherwise, whereas ‘0’ for male and ‘1’ for female). The correlation result is presented in Table 4.4.6.

**Table 4.3: Correlation Result of Climate Change Effect on Gendered Livelihoods**

Sex	Climate Change Effect on Livelihoods		Total
	No	Yes	
Male	25	35	60
Female	8	52	60
Total	33	87	120
Phi Coefficient	0.317		
Chi-Square	12.079***		
Approx. Sig.	0.001		

\*\*\* *Significance level at 1 %*

(Source: Computation from field data, 2015)

From table 4.4.5, the Phi correlation coefficient ( $\Phi$ ) is 0.317, indicating a positive correlation. The Chi-square calculated is 12.079 and this is greater than the critical value of 3.84. The overall model estimates is also significant at 1 per cent. This implies that climate change has differential

effects on the livelihoods of male and female smallholder farmers in the Municipality. Hence the null hypothesis which states “climate change has no differential effect on the livelihoods of men and women smallholder farmers” is rejected in favour of the alternate which states that “climate change has differential effect on the livelihoods of men and women smallholder farmers”.

Furthermore, the results indicates that, droughts, floods and extreme weather events tended to have a positive effect on female smallholder farmers livelihoods in the Municipality while having a negative effect on their male counterparts. The reason for this was attributed to the fact that, more males migrate to the cities to work (mostly in non-agricultural sectors) while leaving the females at home to take care of the children. These emigrated men take longer period to secure jobs and this adversely affects their livelihoods. The females on the other hand take advantage of the prevailing weather conditions and grow crops that can thrive well at that season in order to earn an income and provide for the family. For example, a female participant narrated how she took advantage of the rainy season, which later turned to floods to cultivate rice in the absence of her husband who has migrated to the nearby town to seek employment due to extreme weather conditions.

Also since most emigrant men send money to their wives after securing jobs, these women either invest the money in agricultural production or non-agricultural activities (such as petty trading) which they believe is a sustainable livelihood option (Phuong, 2012).

## CHAPTER FIVE

### RESULTS AND DISCUSSIONS II

#### 5.0 Introduction

This chapter further presents the results of analysis of data gathered during the study. The first part of the chapter covers the coping strategies employed by the smallholder farmers in the Ejure/Sekyedumasi municipal in the face of climate change and extreme weather events. The second part describes institutional perception on climate change and extreme weather events as well as their role in assisting smallholder farmers address the climate change challenge.

#### 5.1 Coping Strategies Employed by Male and Female Smallholder Farmers

As already stated by DFID (1999) and Ellis (1998), smallholder farmers coping strategies in the face of a changing climate includes a diverse portfolio of activities undertaken to safeguard their livelihoods. Livelihood strategies are the activities realized by household members (farm production, off farm activities, migration, etc.), resulting in outcomes such as food or income security (Ellis *et al.*, 2003). These activities are characterized by different allocations of natural (land area, irrigation, soil productivity), physical (working tools, tractors, livestock), financial (access to credit), public (roads, schools, public services), social (civil organizations, migration networks) and human (education, household size, training) assets (Winters *et al.*, 2002). The activities engaged by the households help to identify the different livelihood strategies. These diverse portfolios of activities included on-farm, off-farm and non-farm (Barrett *et al.*, 2001; Little *et al.*, 2001; Reardon, 1997).

Table 5.1 presents analyses for the ranking of coping strategies employed by the respondents. There is a difference in the coping strategies adopted by the smallholder farmers in the

Municipality (Kendall W= 8.8% and significant at 10% level). The most employed coping strategies among the farmers is the on-farm strategies (ranked =1) followed by non-farm (ranked=2) and off-farm strategies (ranked=3).

**Table 5.1: Ranking of Coping Strategies**

Coping Strategies	% of Respondents			% Weighting**	Overall Rank	Kendall W	Chi-Square Significance level
	1	2	3				
On-Farm	50	27.5	22.5	227.5	1	0.088	21.006*
Off-Farm	15	39.2	45.8	169.2	3		
Non-Farm	35	34.5	30.8	204.2	2		

*Note:\*\*This is captured as the sum of % respondents ranking x weight of rank (rank1=3, rank2=2, rank3=1) \*: significant at 10%*

*(Source: computation from field data, 2015)*

### 5.1.1. Ranking of On-Farm Coping Strategies by Men and Women Smallholder Farmers

On-farm coping strategies in the face of climate change and extreme weather events is defined as activities undertaken by farmers on their farms in order to increase production, income, as well as food security (Gecho *et al.*, 2014). Examples include, crop diversification, practicing mixed farming, mixed cropping, irrigation, agroforestry etc.

According to Lopez (2008), coping strategies is based on the intensity of involvement in each of the livelihood capital a household may choose. Coping strategies may require one or a combination of capitals with the purpose of obtaining outcomes (Barret and Reardon, 2000). For example, on-farm strategies such as crop diversification and mixed farming may use natural, human, financial, or physical capital, while off-farm strategy such as agricultural wage employment or migration to cities (non-farm strategy) would use only human capital like education, or social network access and not physical or natural capital (Barret and Reardon, 2000). Of the entire on-farm coping strategies adopted by the smallholder farmers in Ejura/Sekyedumasi Municipal, agronomic practices which included early/late planting, early/late

harvesting, intercropping, irrigation and agroforestry was the most adopted strategy by both men and female smallholder farmers in the face of droughts and floods (see Table 5.1.1). That is, 45 percent and 43.3 percent for women and men smallholder farmers respectively.

**Table 5.2: Ranking of On-Farm Coping Strategies based on Gender**

On-Farm Strategies	Male		Female	
	Frequency	% of respondents adopting the strategy	Frequency	% of respondents adopting the strategy
Agronomic Practices (early or late planting, early or late harvesting, irrigation, intercropping, agroforestry etc.)	26	43.3	27	45
Crop Diversification (Switching crops, use of improve crop variety etc.)	17	28.3	23	38.3
Switching to livestock Production	10	16.7	2	3.3
Integrating livestock with crop	7	11.7	8	13.3
<b>Total</b>	60	100	60	100

(Source: computation from field data, 2015)

*“The weather is not good, there are no rains and the sun is very hot. Because I am farmer who has a wife and children, I have to do my best to cultivate some food crops for the family so I borrow some watering cans from friends and add them to mine to bring water from the river and water my crops”* (Male participant complaining in a FGD).

Crop diversification (i.e. switching from crops and use of improve crop varieties such as drought and pest tolerant crops, early and/or late maturing crops etc.) was the second most adopted on-farm strategy. Also among the smallholder farmers, more women representing about 38 percent were the majority adopters compared to their male counterparts (28 percent).

*“Because the weather is unpredictable of late, we have shifted from the normal planting of maize in May to a different crop say cassava. The reason is that, when you plant maize and expect the*

*rains to come in May, it would not come and you would lose*” (Female participants lamenting in a FGD).

The findings of this research is in line with the works of Gecho *et al.* (2014), Ghosh & Bharadwaj (1992), FAO (2011) and Lopez (2008) who asserted that during extreme weather events such as droughts and/or floods, smallholder farmers, especially women, employ on-farm strategies such as the use of improved crop varieties, plating early/late, harvesting early/late as well as practicing irrigation to safeguard their livelihoods. The reason was that women smallholder farmers have limited capitals (mostly natural and financial) that could not help them explore other coping strategies (Lopez, 2008).

### **5.3 Ranking of Off-Farm Coping Strategies by Men and Women Smallholder Farmers**

According to Alemu (2012) smallholder farmers, especially in Africa, resort to primary agricultural production for their livelihoods but this has failed to guarantee sufficient livelihood for most farming households and primary agricultural development have largely produced little improvement. Reasons were attributed to the climate and extreme weather events as well as high levels of poverty in Africa, which had made investing in agriculture a major challenge. As a result, smallholder farmers switch to a more sustainable livelihood option of which off-farm livelihood strategies is of no exemption.

Off-farm strategies are basically livelihood options undertaken to secure a more sustainable income source and/or supplement on-farm livelihoods (Alemu, 2012). It involves activities or employment undertaken other than on one’s own farm (agricultural laborer), agricultural processing and sales. According to Barrett and Reardon (2000), many factors induce diversification out of primary agriculture or farming. Sometimes diversification is born of desperation, opportunity or risk management. Nonetheless, off-farm strategies help farmers to fill

income and food gap that on-farm strategies were unable to do (Gecho *et al.*, 2014). Further, such strategy provide a way for off-setting the diverse forms of risks and uncertainties (relating to climate change and extreme weather events, finance, markets etc.) associated with agriculture and create a way of smoothing income over years and seasons (Barrett *et al.*, 2001; Reardon, 1997). In addition, lack of sufficient access to important on-farm requisites could force households to look for additional or alternative sources of income including off-farm strategies (Gecho *et al.*, 2014).

**Table 5.1.2: Ranking of Off-Farm Coping Strategies based on Gender**

Off-Farm Strategies	Male		Female	
	Frequency	% of respondents adopting the strategy	Frequency	% of respondents adopting the strategy
Agricultural Labourer (wage employment from other farms)	24	40.0	20	33.3
Processing of Agricultural Commodity	20	33.3	7	11.7
Trading in agricultural commodity	16	26.7	33	55.0
<b>Total</b>	<b>60</b>	<b>100</b>	<b>60</b>	<b>100</b>

(Source: computation from field data, 2015)

According to the smallholder farmers, 40 per cent of the men smallholder farmers were into working as laborers on other people's farms (see Table 5.1.2). These percentages of people were involved weeding, application of chemicals, planting, harvesting and sometimes transporting of foodstuffs from the farm to the house. The women on the other hand (about 33.3 percent) who were agricultural laborers had their work defined. They were mostly involved in planting and harvesting activities. Trading in agricultural commodities such as maize, rice, okra, tomatoes, garden egg, pepper etc. was also a coping strategy that was mostly undertaken by the women

smallholder farmers (55 percent). Only 26.7 percent men smallholder farmers were in similar activities.

*“I have been farming for the past 15 years. The farming business is no more good for me, any time I farm I always make huge loses because either my crops would be destroyed by floods or drought. I decided to stop farming and engage in buying and selling of agricultural produce such as okro, maize, tomatoes, pepper, etc. from the farmers and sell to traders in the markets. This business is very good for me because for this one the rains or droughts does not affect it much”* (Female participant happily contributing to a FGD).

Also more men (33.3 percent) were into agricultural processing activities as a coping strategy than women smallholder farmers (11.7 percent).

*“I was once a farmer who grew mostly food crops. Due to the bad nature of the weather, I stopped because I was making plenty loss. I later engaged myself in milling of maize, tomatoes and pepper. For this business, master, whether rain or shine, I dey get my money”* (Male participant contributing to a FGD).

The findings of this study confirms that Barrett *et al.* (2001) who argue that household reliance on off-farm income diversification is widespread but not all households enjoy equal access to off-farm opportunities.

### **5.1.3 Ranking of Non-Farm Coping Strategies by Men and Women Smallholder Farmers**

Most rural households base their livelihood strategies on multiple activities to manage risky events, and achieve a sustainable stream of income over time. This implies diversifying from an unreliable agricultural income source towards a reliable non-agricultural/non-farm income source with high returns in order to improve wellbeing (Ellis *et al.*, 2003). Non-farm strategies

according to Ellis (2000) represent activities other than agricultural related undertaken by rural households with less risk and uncertainty, to increase income, improve wellbeing, reduce vulnerability as well as increase food security. Examples of non-farm strategies include wage employments from non-agricultural sources such as masonry, carpentry, migration, remittances, property income, government transfers, pensions etc. Haggblade *et al.* (2010) indicated that non-farm income accounts for 35 percent to 50 percent of total rural household income in developing countries. Davis *et al.* (2007) put the global figure at approximately 58 percent.

The share of non-farm income is expected to increase substantially in the coming years, especially in Sub-Saharan Africa where increasing population growth and limited agricultural resources are threatening the growth of the agricultural sector (Haggblade *et al.*, 2007). For instance in Ghana, Jolliffe (2004) found out that, out of the total 74 per cent of rural farming household, 33 per cent were engaged in off-farm strategies while the remaining 41 percent were into non-farm strategies. According to table 5.1.3 below, more men smallholder farmers (about 47 percent) migrate to the cities especially further from their residence to look out for menial jobs.



**Table 5.4: Ranking of Non-Farm Coping Strategies based on Gender**

Non-Farm Strategies	Male		Female	
	Frequency	% of respondents adopting the strategy	Frequency	% of respondents adopting the strategy
Migration to the cities	28	46.7	10	16.7
Wage employment from non-agricultural activities (masonry, carpentry, petty trading, formal occupation etc.)	13	21.7	25	41.7
Remittances (from relatives, friends etc.)	9	15	20	33.3
Property Income (such as from rent from land, houses, stalls and others)	8	13.3	5	8.3
Government grants/pension	2	3.3	0	0
<b>Total</b>	<b>60</b>	<b>100</b>	<b>60</b>	<b>100</b>

(Source: computation from field data, 2015)

These menial jobs included working mainly as factory hands and constructional workers. On the other hand only 16.7 percent of the women smallholder farmers migrate but to neighboring towns and engage in less stressful activities such as cleaners in homes and restaurants, store keepers, hawkers of various commodities etc. (Gecho *et al.*, 2014).

*“For the past 10-15 years, I have been engaging myself in constructional work as a mason. I own an 8 acre cocoa farm but due to the low level of productivity, caused by extreme weather events, resulting in low income, I have to periodically (5 times in a year) move to Abokobi, Weija and Tema (towns in Accra) to work in order to get some money to supplement the little my wife is making in the village for the upkeep of the family”.* (Extract from a Male key informant interview)

*“The farming work has now spoiled because the weather is not good. When you plant, it does not come. Because of that, every year from January to April and also from September to November, I*

*go to Kumasi to work as a cleaner in a chop-bar. The chop-bar money is not good but it is better than the farming I was doing”* (Extract from a Female key informant interview).

Comparing wage employment from non-agricultural sectors, women smallholder farmers assumed majority (25 out of 60 respondent) while men smallholder farmers assumed 13 out of 60. As part of non-farm coping strategies in the face of climate change, about 13.3 and 8.3 percent of men and women smallholder farmers respectively generate their livelihoods from either renting out their lands, houses, stalls or other personal assets. In addition, 33.3 percent of women smallholder farmers resort to remittances from family and friends while that of the men smallholder farmers was 15 percent (Gecho *et al.*, 2014).

*“My husband is a native of this land and a farmer. In 2004 he lost his farm to wildfires, which was partially caused by drought and high temperatures. He decided to move to the city but I advised him to farm on my land but declined saying that the farm work is difficult aside that the pay is not good. He later moved to the city and worked as a bus driver while I stayed back farming on my 1-acre land. As time went by he started sending me money to supplement what I was making from the sales of my produce”* (Female Participant from FGD 2)

## **5.2. Role of Institutions in Climate Change Adaptation**

Climate change impacts as already stated by IPCC (1997) would be felt globally but adaptation to these impacts would need to be context specific as a result, there is the need to develop local adaptation measures to help address the challenges. Because adaptation to climate change would need to occur locally, it is critically important to understand the role of local institutions if adaptation is to help the most vulnerable social group (Agrawal, 2008). According to Agrawal (2008), adaptation to climate change should be localized and its effectiveness depends on local

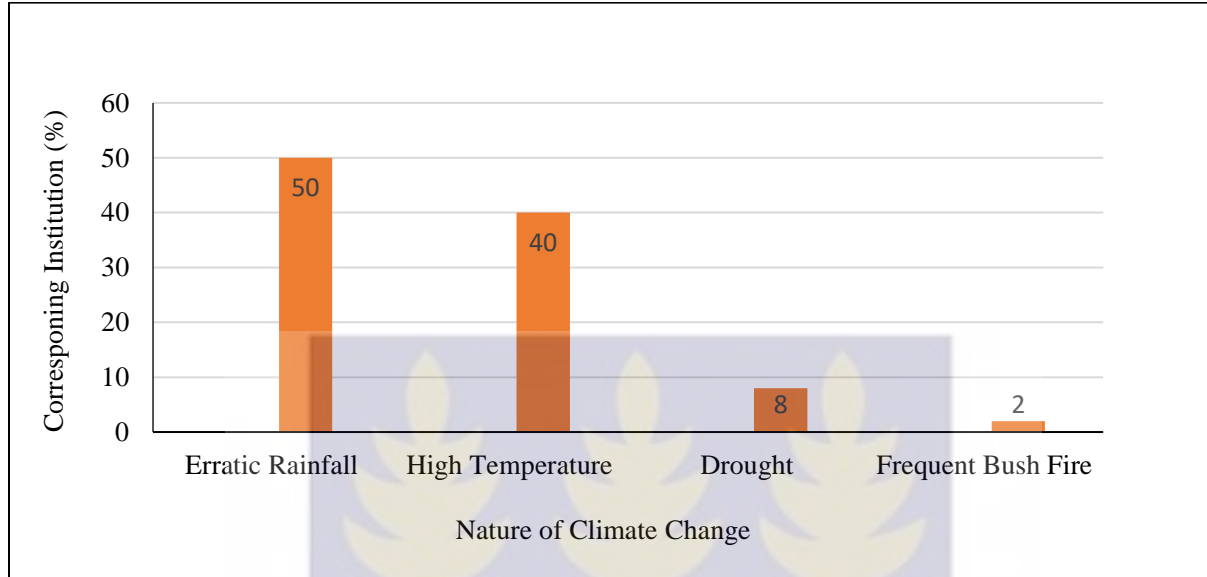
and extra-local institutions through which incentives for individuals and collective actions are structured.

The study provides detailed information about institutional participation in activities that support households to adopt climate change adaptation practices. As part of the study, institutional perception on climate change and extreme weather events was conducted. In all, six institutions were visited (but three different types based on Agrawal *et al* (2008) classifications of institutions), namely the Ghana Cocoa Board (COCOBOD), Forestry Commission (FC) and Ministry of Food and Agricultural (MoFA) (which were all public/government institutions); Rural Banks (e.g. Sefwiman and Sekyedumasi rural bank which are both private institutions) and World Vision International (WVI) (a civic institution).

### **5.2.1. Institutional Perception on Climate Change**

For all the institutional surveys, the respondents were mainly senior management personnel, directors and manager. The frontline staff included a front desk officer, credit officer and customer relation's officer.

From the survey, all the institutions were aware of climate change, however, 3 institutions representing 50 per cent attributed erratic rainfall as the major sign of climate change, high temperature accounted for 40 per cent while persistent drought and frequent bush fires assumed 8 and 2 percent respectively (see Figure 5.2.1). Out of the six institutions visited, four namely; MoFA, FC, COCOBOD and WVI agreed that, changes in climatic factors were contributed mainly by human activities (such as bush fires, deforestation and inappropriate use of agrochemicals). Hence they insisted that institutional supports should address both mitigation and adaptation.

**Figure 5.2.1: Institutional Perception on Climate Change**

(Source: Computation from field survey, 2015)

### 5.2.2. Institutional Services Addressing Climate Change

According to Agrawal *et al.* (2008) institutions play a crucial role in shaping adaptation to climate change by first of all connecting households to local resources and collective action; determining flows of external support to different social groups; and linking local populations to national interventions.

From the study, results indicated that government/public institutions primarily led by the Ministry of Food and Agriculture (MoFA) was involved in helping the smallholder farmers in the Municipality address the climate change challenge (USAID & MFCS, 2014). Their activities were implemented in close collaboration with other institutions such as the COCOBOD, Forestry Commission and World Vision International. The services that were provided by these institutions to help the farmers address climate change ranged from technology transfer, education and training, and credit provision.

### **5.2.2.1. Education and Training Services**

From the survey conducted, four of the institutions provided capacity building services to farmer groups to improve their knowledge and skills in farm and environmental management (Notable among them is MoFA, FC, COCOBOD and WVI). Mostly the educational services included: when to plant, harvest, when to apply agrochemicals and the right dosage, the use of drought-tolerant varieties of seed and rainwater harvesting, climate change awareness creation, and training on preventing forest deforestation and degradation

As already stated that women smallholder farmers stood the chance of losing their livelihoods to climate change and extreme weather events, institutional survey showed that discrimination of beneficiaries based on gender, marital status, and economic activities were not found to be practiced by any of the institutions except WVI who provided preferential services to mainly women smallholders. These services accorded to these women included training in advocacy roles for the local resistance to climate hazards, training and capacity building on other livelihoods options such as, beads making, mushrooms, snails and grass cutter farming as well as workshop on climate change mitigation and adaptation measures.

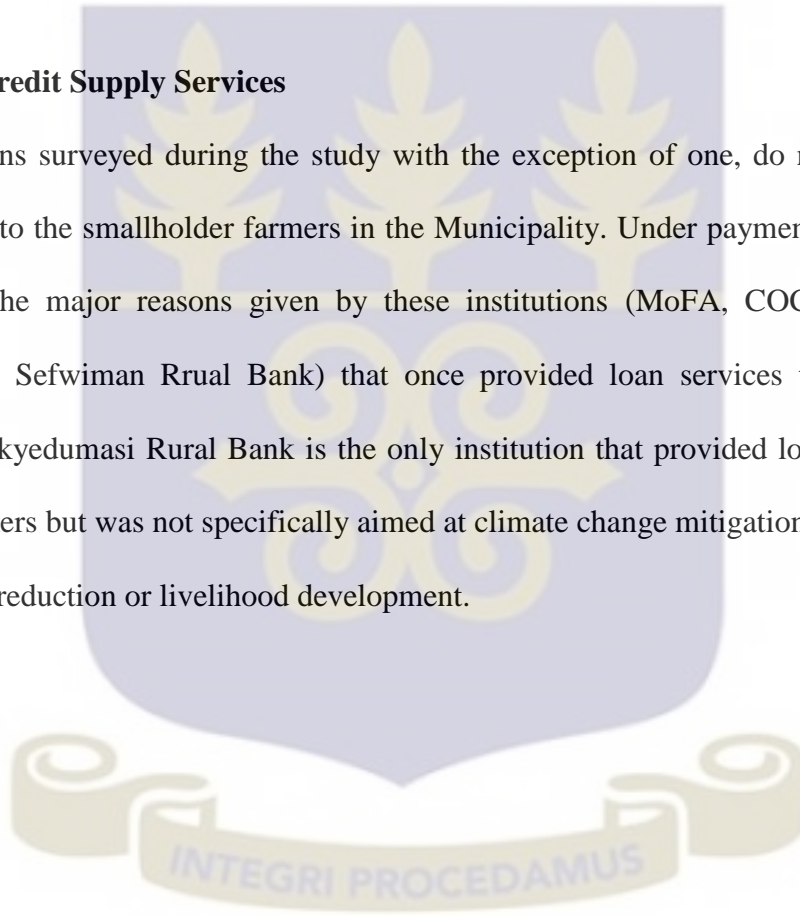
### **5.2.2.2. Technology Transfer Services**

The study also identified that; some of the institutions were involved in technology transfer in one way or the other to the smallholder farmers in the Municipality to help them address the effects of climate change. The technology transfer options were categorized into biological, chemical, mechanical or management (USAID & MFCS, 2014). The key biological option transferred was improved seed varieties (in terms of maturity and resistance to drought and pest); chemical options included chemical fertilizers, pesticides and herbicides. Provision of tractor and equipment (mostly irrigation equipment) formed part of the mechanical technology options

transferred by the institutions while the managerial options involved innovations that are particularly related to agronomic practices such as use of cover crops, mixed farming, mixed cropping, planting on ridges, mulching, among others (USAID & MFCS, 2014; Agrawal, 2008). The major institutions that were associated with these technology transfers services were the MoFA and COCOBOD. Beneficiaries included both men and women with land sizes of 1.5 acres and above.

### **5.2.2.3. Credit Supply Services**

All the institutions surveyed during the study with the exception of one, do not provide credit support services to the smallholder farmers in the Municipality. Under payment or non-payment of credit were the major reasons given by these institutions (MoFA, COCOBOD, Forestry Commission, and Sefwiman Rural Bank) that once provided loan services to farmers in the Municipality. Sekyedumasi Rural Bank is the only institution that provided loan services to the smallholder farmers but was not specifically aimed at climate change mitigation or adaptation but towards poverty reduction or livelihood development.



## CHAPTER SIX

### SUMMARY, CONCLUSION AND RECOMMENDATIONS

#### 6.0 Introduction

In this chapter, the summary and conclusion of the results are presented in sections 6.1 and 6.2 respectively. The chapter also presents policy recommendation based on the findings from the study.

#### 6.1. Summary of Study

Climate change is causing unusual, unpredictable and extreme weather events in the two farming communities where this study was conducted. Although the level of exposure to climate change affects everyone in these communities, its impacts are differently distributed between genders. The main objective of this study was to analyse the effects of climate change on the livelihoods of both men and women. The study employed the use of both primary and secondary data. Multistage sampling techniques were used to select the respondents. The first and second objective of the study described smallholder farmers' perception on climatic change and the effects of this changing climate on their livelihoods respectively. The DFID and Oxfam livelihood approach guided the analyses on climate change impact on gendered livelihoods. In analysing the coping strategies employed by male and female smallholder farmers in the face of climate change, the Kendall's coefficient of concordance was used.

From the descriptive analysis, the age range for the respondents was between 40-90 years with majority of them being married (73 per cent). More women smallholder farmers than men have larger household size, involving 6-10 members. Almost all of the respondents derived their income from agriculture but majority, about 62 per cent of women primarily engage in primary

agriculture production for their livelihoods. Also about 87 per cent of the respondents had formal education with majority (about 57 per cent) being male smallholder farmers,.

The study identified that smallholder farmers had noticed and were aware of climate change and variability in the study area. Attributions of climate change happenings in the municipal included severe storms and floods, extreme hot weather and droughts resulting in drying up of major water bodies. Majority of the respondents, with greater percentage being males, perceived temperature had increased and attributed it mainly to deforestation. Similarly, majority of the males' perceived rainfall had decreased in amount and increased in variability. The perceived changed was attributed mainly to deforestation and bush burning. The study further analysed the historical mean annual temperature and rainfall for the study area and this was in agreement with what was perceived by the farmers.

The DFID and Oxfam livelihood approach used to analyse the effects of climate change on gendered livelihoods showed that more women than men in the study area were affected adversely by climate change impacts. This was due to the differences in socially constructed roles and responsibilities that are based on tradition. These factors have direct negative impact on women's assets, their access to economic resources and the options available to them in pursuing optimal livelihood strategies. Furthermore, the Phi correlation of value, 0.317 showed a differential effect of climate change on gendered livelihoods.

The study also examined the coping strategies employed by the farmers to safeguard their livelihoods using the Kendall's coefficient. The most dominated coping strategy employed by the farmers was on-farm strategies and the least was the off-farm strategies. Majority of the women adopted the on-farm strategies while most men adopted the non-farm strategies.

Institutions that assisted smallholder farmers adopt adaptation practices were also examined by the study. All the institutions visited perceived climate has change and attributed it to deforestation, bush burning and inappropriate use of agrochemicals. Government or public institutions such as MoFA, COCOBOD and FC solely provided education and training services to farmers. WVI being the only civic institution in the Municipal provided both education and training services to the farmers. In addition they also took up the responsibility of transferring technologies that aids farmers' adaptation to climate change. Twoprivate institutions, namely Sewfiman and Sekyedumasi Rural Bank undertook the provision of credit services to support livelihood development in the Municipal.

## **6.2. Conclusion**

The thesis centred on the effects of climate change on men and women livelihoods, their perceptions on climate change, their gendered responses to climate change impacts and the role of institutions in assisting them adapt to climate change challenges. From the results of the study, the following conclusions can be drawn:

1. Most of the smallholder farmers in the study area had noticed and were aware of climate change but more men considered changes and variation in temperature and rainfall than women. Deforestation and bush burning were the main cause of climate change in the study area.
2. Climatic phenomenon happening in the Municipality includes extended times of severe storms and floods, extremely hot weather and droughts resulting in drying up of water bodies.
3. Climate change differentially affects men and women's agricultural livelihoods in the Municipality. Women's livelihoods, in the form of loss of food crop yields and income

reduction, and increase in health related diseases was the main effects of climate change while that of the men was loss of cash crop yields as well as income reduction.

4. In the face of climate change both men and women tried to take actions to protect themselves and their livelihoods. Among the actions taken, on-farm coping strategy, in the form of crop diversification was the most adopted strategy by the female smallholder farmers while the male smallholder farmers took to off-farm (working as labourers on other farms) and non-farm coping strategies (migration to the cities for better income earning opportunity).
5. Institutions that assisted the smallholder farmers address the climate change challenge perceived deforestation, bush burning and inappropriate use of agrochemicals as the main human activities responsible for the changing climate. As part of their services, education and training, transfer of appropriate technology and provision of credit were the major support these institutions provide to the smallholder farmers to assist them address the climate change challenge.

### **6.3. Recommendation and Suggestion for Future Research**

From the key findings of this study, a number of policy intervention and recommendations are identified. These are:

1. Since more male smallholder farmers were aware of climate change and its attributions than their female counterparts, it is suggested that climate change awareness programmes should target both sexes, in order to build their capacity to cope with climate change stresses and uncertainties on local livelihoods.
2. Climate change affects more of women's agricultural livelihoods, hence it is necessary to mainstream their voices, needs, and expertise in climate change debate, policy and

programming so as to design gendered-tailor made adaptation measures to help address the climate change challenges.

3. From the institutional survey, government and civic were the only institutions actively assisting smallholder farmers' address the climate change challenge. Private institutions in the form of rural banks were not involved in addressing the climate change challenge in the municipal. Therefore public/government institutions should recognize their leadership role and ensure effective collaboration between the other of institutions in order to develop appropriate adaptation or coping strategies that would aid the farmers address climate change challenge in the Municipality.
4. Awareness should be raised by the right institutions such as MoFA, Ministry of Gender and Social Protection through workshops and informal educational programs on the linkage between agriculture, climate change and gender equality and their importance in relation to the development of the Municipality and the country as a whole.

It is suggested that future researchers should look at climate change effects on the outputs of men and women smallholder farmers as well as their income differential those who adapt to climate change and those who do not adapt to climate change.

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**SAMPLE QUESTIONNAIRE FOR FARMERS**  
**CLIMATE CHANGE AND ITS EFFECTS ON SMALLHOLDER FARMERS’**  
**LIVELIHOOD: THE CASE OF EJURA/SEKYEDUMASI MUNICIPAL OF THE**  
**ASHANTI REGION OF GHANA**

**This questionnaire seeks to obtain information on the effect climate change is having on the livelihoods of both male and female small-holder farmers, their livelihood strategies in the face of climate change, as well as their perceptions on climate change.**

**This interview is purposively for academic work and entirely anonymous. No one will know your name and so you may speak quite freely to the interviewer. We thank you for your time and assistance in our work.**

**Reference Information**

Name of Respondents..... Serial Number.....  
Mobile Number..... Date of Interview ....../..../2015  
Name of Town/Village..... Name of Municipality.....

**A. Demographic Information**

1. Age of respondent: .....
2. Gender of respondent: 0. Male 1. Female
3. Education of respondent: 1. None 2. Primary Education 3. Middle/JSS  
4. SSS/Tech/Voc 5. Training Colleges f. Tertiary
4. Marital Status: 0. Single 1. Married 2. Divorced/Separated 3. Widowed
5. Religion: 1. Traditional religion 2. Christian 3. Muslim 4. Other, specify.....
6. Ethnicity: 1. Akan 2. Fante 3. Enzema 4. Ewe 5. Ga 6. Dagomba 7. Other, specify.....
7. Place of Origin of respondent: 1. Native 2. Settler/Migrant 3. Other, specify.....
8. How often do you stay/reside in the community/village: 1. Stay during the farming season 2.  
Stay throughout the year.
9. Years of farming experience of respondent: .....
10. Is the respondent the head of household: 0. No 1. Yes
11. If no, provide name of household head: .....
12. Sex of Household Head: 0. Male 1. Female

13. Age of Household Head: .....
14. Household Size: .....
15. Type of land ownership: 1. Own land (purchased/Inherited) 2. Rented 3. Shared holding
16. Do you belong to a Farmer Based Organizations (FBOs) or any Cooperative: 0. No 1. Yes
17. If yes to question 16, name the organization/cooperative.....  
 .....

**18. Sources of Income (Please complete the table below)**

Source of Income	Amount in GHS
1. Farming (sales from last harvest)	
2. Off-farm activities (e.g. laborer)	
a. Wage	
b. kind (estimate in monetary terms)	
3. Petty trading	
4. Formal Occupation (e.g. teacher, nurse etc.)	
5. Remittances	
6. Pension / government transfers	
7. Other, specify	

**B. Perception on Climate Change**

19. Do you think the weather conditions have changed over the past 10 years?  
 0. No 1. Yes 3. Do not know
20. What do you think is the cause of this changes?  
 1. God/gods 2. Deforestation 3. Bush burning 4. Increased population 5. Others (specify).....
21. Temperature has changed over the past 10 years?  
 1= Strongly disagree 2= do not know 3= Strongly agree.
22. What do you think is the cause of this changes?  
 1. God/gods 2. Deforestation 3. Bush burning 4. Increased population 5. Others (specify).....
23. How has it changed over the past 10 years?  
 0. It has decreased 1.it has increased 2. Don't Know 3. No change
24. Rainfall amount has changed over the past 10 years

1= Strongly disagree 2= do not know 3= Strongly agree

What do you think is the cause of this changes?

1. God/gods 2. Deforestation 3. Bush burning 4. Increased population 5. Others (specify).....

25. How has it changed over the past 10 years?

0. It has decreased 1.It has increased 2. Don't Know 3. No change

**C. Climate Change and Extreme weather Effect on Livelihoods.**

26. Has climate change affected any aspect of your livelihoods including agricultural production?

0. No 1. Yes

27. If answered yes to question 25, how has it affected your livelihoods? Explain.....

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

**C. 1 Climate Change Effect on Human Capital**

28. Has climate change affected the health conditions of you and your family?

0. No 1. Yes (if yes, is it positive or negative)

29. Has climate change resulted in the death of a family member?

0. No 1. Yes

30. Has climate change affected your access to labor?

0. No 1. Yes (if yes, is it positive or negative)

31. Has climate change increased the workload of family members?

0. No 1. Yes (if yes, is it positive or negative)

**C.2 Climate Change Effect on Natural Capital**

32. Has climate change affected the wildlife/forest reserves in the community?

0. No 1. Yes (if yes, is it positive or negative)

33. Has climate change affected your agricultural land?

0. No 1. Yes (if yes, is it positive or negative)

34. Has climate change affected the water resources (streams, rivers, ponds, well, etc.) in the community?

0. No            1. Yes (if yes, is it positive or negative)

### **C.3 Climate Change Effect on Social Capital**

35. Has climate change affected your participation in social organizations/social networking (e.g. funeral, weddings, durbar, outdoorings etc.) in the community?

0. No            1. Yes (if yes, is it positive or negative)

36. Has climate change affected your participation in decision-making at the household/community level?

0. No            1. Yes (if yes, is it positive or negative)

37. Has climate change affected your participation in informal/non-formal educational activities organized by FBO's or other organization in the community?

0. No            1. Yes (if yes, positive or negative)

### **C.4 Climate Change Effect on Physical Capital**

38. Has climate change affected your family shelter/buildings (including storage facilities)?

0. No            1. Yes (if yes, is it positive or negative)

39. Has climate change affected your water supply in the community?

0. No            1. Yes (if yes, is it positive or negative)

40. Has climate change affected your electricity supply in the community?

0. No            1. Yes (if yes, is it positive or negative)

41. Has climate change affected the transportation and road networks in the community?

0. No            1. Yes (if yes, is it positive or negative)

42. Has climate change affected any public building (school, clinic/hospital, community center, etc.) in the community?

0. No            1. Yes (if yes, is it positive or negative)

### **C.5 Climate Change Effect on Financial Capital**

43. Has climate change resulted in the loss of your personal belongings (clothes, tv, radio) and equipment (cutlass, hoe, basket etc.)

0. No            1. Yes

44. Has climate change resulted in your crop and/or livestock damages?

0. No            1. Yes

45. Has climate change resulted in migration of a family member and/or loss of income earning opportunity?

0. No            1. Yes

46. Has climate change affected your access to credit?

0. No            1. Yes (if yes, is it positive or negative)

**D. Livelihood Strategies used by Smallholder Farmers in the face of Climate Change**

47. Which of the following livelihood strategies do you employ during periods of climate change and extreme weather events? Please rank from most used (1) to least used (3):

Livelihood Strategies	Rank
<b>A. On-Farm Strategies</b>	
Crop diversification (including switching from crops, usage of improved crop variety etc.)	
Switching to livestock production	
Integration of crop and livestock production	
Agronomic practices (changing planting date, intercropping, irrigation, agroforestry, mulching, etc.)	
<b>B. Off-Farm Strategies</b>	
Wage from agricultural activities other than own farm: Laborer on other farms	
Processing of agricultural produce	
Sales of agricultural produce, etc.)	
<b>C. Non-Farm Strategies</b>	
Wage employment other than from agriculture (petty trading, carpentry, masonry, teacher, etc.)	
Migration to cities	
Remittances (e.g. from relatives and friends)	
Property income (such as houses, stores, land, etc.)	
Government grants and transfers (pension)	

E. Do you have any questions relating to this study?

.....

.....  
.....

F. How best do you think your livelihood can be improved in the face of climate change?

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



## INTERVIEW GUIDE FOR FOCUS GROUP DISCUSSION

1. Has there been a significant change in weather variables over the last 10 years?  
(Such as temperature, rainfall amount, duration and distribution, sunshine, heat spell etc.)
2. How has the changes been like?
  - (i) For temperature
  - (ii) For rainfall
  - (iii) Other weather variables
3. Has there being change(s) in the agricultural production output (crop yields/livestock production) for both men and women in the community?
4. What accounted for these changes? (i) Extreme weather/climate change events (floods, droughts, heat spell etc.) (ii) Pest/diseases (iii) soil infertility issues
5. If extreme weather/climate change events were a factor, what was the main problem caused by such events. (ask of effects on both men and women)
6. What are the effects of climate change on these livelihood assets:
  - i. Human capital**
    - Effect on health/death
    - Access to labour
    - Effect on workload
  - ii. Natural capital**
    - Effect on wildlife/forest
    - Effect on agricultural land
    - Effect on water resource
  - iii. Physical capital**
    - Effect on shelter/personal buildings (storage facilities etc)
    - Effect on water supply
    - Effect on electricity
    - Effect on public goods (schools, clinics, roads, community centres, etc.)
  - iv. Social capital**
    - Effect on participation in social organization/networking

- Effect on decision-making at household/community level
- Effect on participation in informal/non-formal educational activities.

**v. Financial capital**

- Effect on personal belongings & equipment
  - Effect on crops and/or livestock
  - Effect on migration and income earning opportunity
  - Effect on access to credit
7. In the face of extreme weather events/climate change what are the strategies employed to safeguard your livelihoods?
  8. Are the members of the communities (specifically smallholder farmers) assisted by any institution to help address the climate change impacts?
  9. State the institutions involve
  10. What type of services do these institutions provide?
  11. Do every member of the community benefit from such services?
  12. State the beneficiaries of the support services. (e.g. women only, men only, children, the aged, large scale farmers, small scale farmers, etc.)



## INTERVIEW QUESTIONS FOR INSTITUTIONS

### A. Institutional Background

Position of interviewee.....

Date .... /.../15

Name of Institution.....

Type of Institution (i) Public (ii) Civic (iii) Private

Its vision: .....  
.....  
.....

Its mission: .....  
.....  
.....

How many years has the organization been in existence?.....

How many years has the organization been operating in the community?.....

### B. Climate Change Impacts

1. Do you perceive climate is changing in the community?
2. What do you think might be the causes?
3. Can you describe how the changing climate affects the livelihoods of the community members (including smallholder farmers).
4. How does your institution contribute to support the community address the climate change challenges? (e.g education and training; cash aid, food aid and credit; infrastructure improvement; technology transfer; business advice)
5. Does every member of the community benefit from these support services?
6. If no, state target group of beneficiaries
7. What are the challenges your institution is facing in supporting the community address climate change challeng

APPENDICES

Appendix 1: Rainfall Amount (mm) for Ejura/Sekyedumasi Municipal

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual/sum
1984	0.0	11.2	150.2	117.9	180.0	152.8	196.3	180.9	168.7	127.5	0.0	0.0	1285.5
1985	18.3	2.8	97.4	117.9	92.2	120.0	233.8	180.3	336.2	128.9	10.9	0.0	1338.7
1986	0.0	23.4	204.9	164.9	253.5	211.6	199.0	62.1	174.8	224.1	23.5	0.0	1541.8
1987	24.4	9.9	78.7	107.6	101.0	272.0	231.2	200.7	316.8	147.6	0.0	0.0	1489.9
1988	0.0	32.8	80.5	100.4	206.8	234.9	198.5	14.2	180.4	149.4	27.1	39.8	1264.8
1989	0.0	3.1	142.8	155.7	68.2	372.8	270.3	100.5	225.3	174.7	7.8	6.3	1527.5
1990	0.0	36.5	0.0	114.1	128.7	134.0	39.4	75.0	256.9	102.6	133.1	125.0	1145.3
1991	0.0	55.1	121.9	143.9	218.3	183.9	96.7	17.9	185.2	182.4	0.8	1.3	1207.4
1992	0.0	0.0	16.7	82.0	133.5	179.8	205.8	13.4	106.7	168.7	19.1	0.0	925.7
1993	0.0	57.9	105.8	110.2	176.9	154.5	16.3	109.0	339.3	260.8	0.0	1.0	1331.7
1994	0.0	0.0	0.0	125.4	149.1	75.5	22.4	30.8	156.9	285.3	26.5	0.0	871.9
1995	0.0	2.3	69.7	153.6	117.6	153.2	193.1	76.3	326.6	171.2	40.7	164.7	1469.0
1996	10.7	89.5	63.2	268.3	294.7	120.5	110.0	52.8	182.1	132.0	0.0	10.5	1334.3
1997	55.5	0.0	81.7	189.0	276.7	207.2	89.7	85.2	237.5	206.9	4.3	0.0	1433.7
1998	1.0	36.8	3.5	234.6	91.1	235.4	76.7	117.7	158.0	262.3	3.5	62.0	1282.6
1999	15.9	27.9	217.0	223.5	79.6	163.9	187.6	122.7	142.4	167.2	42.9	0.0	1390.6
2000	16.0	0.0	78.7	144.8	127.2	234.9	133.1	127.9	164.9	33.3	4.9	0.0	1065.7
2001	0.0	0.0	97.1	248.1	123.1	142.5	88.3	29.2	282.7	105.2	7.6	0.0	1123.8
2002	4.7	16.4	81.0	146.3	222.9	227.5	168.6	114.3	211.9	116.9	33.6	31.8	1375.9
2003	4.3	80.9	108.8	154.3	108.0	265.6	35.8	27.0	239.6	137.4	155.7	7.5	1324.9
2004	24.3	23.8	115.9	125.0	289.5	72.5	115.5	215.2	198.1	180.7	80.7	15.5	1456.7
2005	0.7	35.2	134.8	204.5	133.4	94.8	46.5	98.9	234.3	182.2	120.5	0.4	1286.2
2006	32.7	23.9	66.4	54.8	383.7	167.9	79.4	8.7	251.9	366.8	34.5	0.0	1470.7
2007	3.9	0.0	91.7	209.8	188.0	155.9	165.0	23.1	311.8	237.7	53.0	47.6	1487.5
2008	0.0	2.4	136.2	138.1	201.5	248.1	159.2	77.9	205.9	94.4	13.2	10.9	1287.8
2009	0.0	48.6	102.4	162.7	102.6	289.4	235.6	60.6	78.7	128.9	97.2	12.9	1319.6
2010	0.0	38.2	61.5	127.6	224.2	166.1	161.3	248.3	198.2	221.3	127.0	0.0	1573.7
2011	0.0	30.5	58.9	77.3	116.1	320.5	85.8	103.6	181.1	217.7	0.0	0.0	1191.5
2012	1.8	48.1	48.3	118.6	93.1	0.0	0.0	4.7	151.7	0.0	112.2	9.4	587.9
2013	0.0	88.2	79.0	106.3	297.7	75.1	101.5	5.1	129.4	220.3	0.0	0.0	1102.6
2014	29.4	24.5	87.6	165.3	0.0	0.0	81.0	74.8	0.0	0.0	0.0	0.0	462.6

Appendix 2: Minimum Temperature (°C) for Ejura/Sekyedumasi Municipal

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1984	0.0	22.3	23.4	23.5	22.8	22.3	0.0	22.0	21.5	21.9	22.4	0.0	22.5
1985	21.7	21.9	23.9	23.5	23.2	21.6	20.4	21.4	21.2	21.7	22.2	18.7	21.8
1986	20.1	23.6	23.0	23.2	23.0	22.0	21.8	21.3	21.3	21.5	21.5	18.4	21.7
1987	21.4	23.1	23.5	24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.9	22.1	22.4	22.5	19.7	21.7
1989	18.9	21.6	23.0	23.4	23.0	22.2	22.1	22.0	21.9	22.2	22.7	21.1	22.0
1990	21.9	21.6	24.8	23.8	23.2	22.6	22.0	21.9	21.8	21.9	22.5	21.1	22.4
1991	20.6	22.7	22.7	22.9	23.0	22.7	22.2	22.0	22.3	21.5	22.1	19.7	22.0
1992	19.0	22.6	24.2	23.6	22.8	22.2	21.5	21.2	21.1	21.8	20.4	20.1	21.7
1993	18.7	22.8	22.0	0.0	23.1	22.1	22.0	21.8	21.6	0.0	0.0	20.1	21.6
1994	19.7	0.0	0.0	23.0	22.6	22.2	22.3	22.4	22.6	22.1	21.6	21.8	22.0
1995	18.2	21.5	23.6	23.2	23.1	22.5	22.5	22.5	21.8	21.6	21.3	21.8	22.0
1996	21.9	22.3	22.1	22.4	22.4	22.6	21.1	21.2	20.9	20.5	19.0	20.9	21.4
1997	20.6	19.8	22.7	21.4	21.2	0.0	0.0	0.0	0.0	22.0	22.1	19.1	21.1
1998	15.4	19.5	24.8	24.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.2	21.1
1999	21.1	19.6	21.5	21.6	21.6	21.5	21.4	21.1	21.4	21.4	21.4	18.1	21.0
2000	20.4	14.9	22.5	21.8	21.7	21.6	20.6	20.7	21.3	21.3	21.4	19.5	20.6
2001	20.3	13.2	21.6	21.4	21.9	21.9	21.8	22.0	21.8	22.6	22.7	23.2	21.2
2002	18.4	18.7	18.6	19.5	20.3	19.6	16.3	15.3	14.6	15.4	15.7	13.0	17.1
2003	13.7	17.1	17.5	17.2	17.0	15.7	15.4	15.8	15.7	15.9	15.5	14.1	15.9
2004	15.3	17.1	18.6	17.1	16.3	15.4	15.0	15.1	15.5	16.5	16.1	17.0	16.3
2005	14.2	17.5	16.6	17.1	16.9	16.0	15.3	15.9	15.8	16.0	16.5	15.8	16.1
2006	16.1	16.8	17.0	17.3	15.6	15.7	22.9	22.6	22.5	22.6	22.1	21.5	19.4
2007	19.5	0.0	23.9	23.1	23.5	22.7	22.3	22.3	22.1	22.3	22.6	21.2	22.3
2008	17.2	22.5	23.8	23.2	23.2	22.7	22.5	22.4	22.7	22.6	23.1	22.7	22.4
2009	0.0	23.7	23.9	23.6	23.8	22.6	22.2	22.9	22.8	23.0	22.0	22.8	23.0
2010	22.7	24.3	24.9	0.0	24.4	23.8	22.5	22.6	23.1	24.5	23.4	22.4	23.5
2011	19.7	21.3	21.6	23.6	24.0	22.9	22.5	22.8	23.0	22.7	23.4	19.8	22.3
2012	19.7	23.3	24.1	24.0	23.4	0.0	0.0	22.3	23.0	0.0	23.4	21.8	17.1
2013	20.5	23.3	24.1	24.1	23.5	23.4	0.0	0.0	22.3	23.0	0.0	23.4	22.3
2014	22.3	23.4	24.3	24.0	0.0	0.0	0.0	0.0	0.0	0.0	18.2	20.5	19.2

**Appendix 3: Maximum Temperature (°C) for Ejura/Sekyedumasi Municipal**

<b>Year</b>	<b>Jan</b>	<b>Feb</b>	<b>Mar</b>	<b>Apr</b>	<b>May</b>	<b>Jun</b>	<b>Jul</b>	<b>Aug</b>	<b>Sep</b>	<b>Oct</b>	<b>Nov</b>	<b>Dec</b>	<b>Average</b>
1984	0.0	36.7	34.4	33.7	32.6	31.6	0.0	30.6	30.0	31.4	33.2	0.0	32.7
1985	34.6	35.9	35.0	33.4	33.4	31.6	29.8	30.3	30.1	32.0	32.9	32.0	32.6
1986	34.5	36.1	33.2	33.2	32.6	31.2	29.7	29.9	30.6	31.2	32.2	32.5	32.2
1987	34.5	36.1	35.8	34.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.3
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0	30.5	31.9	33.2	32.1	31.5
1989	33.8	35.6	34.9	33.9	33.2	31.4	30.4	29.5	29.7	31.2	33.7	33.2	32.5
1990	34.7	35.5	37.6	34.5	32.7	31.9	29.6	30.1	30.4	31.8	32.9	31.8	32.8
1991	33.4	35.6	34.6	34.0	32.5	32.2	30.8	30.5	31.5	31.2	32.7	32.7	32.6
1992	34.2	37.0	36.8	34.7	32.9	31.2	29.3	29.6	30.6	32.0	32.5	33.6	32.9
1993	34.6	36.2	34.2	0.0	34.4	31.9	30.5	29.3	30.0	0.0	0.0	32.2	32.6
1994	33.3	0.0	0.0	33.4	32.5	31.4	30.3	31.5	30.6	31.2	0.0	0.0	31.8
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.9	32.3	33.0	32.9	32.3
2001	34.7	36.3	35.3	33.6	33.4	32.3	30.6	29.3	30.4	32.5	33.1	31.7	32.8
2002	35.2	37.4	36.2	33.8	33.8	33.3	31.0	29.9	31.1	32.3	34.4	33.0	33.5
2003	34.4	35.6	36.9	34.3	34.2	31.6	31.1	31.4	31.5	32.7	33.1	32.9	33.3
2004	34.2	36.2	36.1	34.4	33.4	31.5	31.2	30.5	31.7	32.5	33.3	34.4	33.3
2005	34.3	36.7	36.7	35.9	34.4	31.6	30.9	30.3	30.9	33.2	34.2	34.2	33.6
2006	34.8	36.5	36.2	36.7	33.5	32.6	31.8	30.0	30.6	32.0	33.3	34.8	33.6
2007	34.6	0.0	37.1	34.5	33.9	32.5	31.8	30.7	31.4	32.3	33.6	32.7	33.2
2008	33.3	36.4	36.0	34.6	33.9	32.4	30.8	31.0	31.4	32.4	33.7	34.4	33.4
2009	0.0	36.1	35.4	35.1	34.4	32.8	31.1	30.3	31.6	32.4	32.8	33.7	33.2
2010	35.6	36.7	36.0	0.0	33.9	32.1	30.8	30.4	30.5	32.0	33.1	0.0	33.1
2011	34.7	35.5	37.6	34.5	32.7	30.0	29.6	30.1	30.4	31.8	32.9	31.8	32.6
2012	33.4	35.6	34.6	34.0	32.5	32.2	30.8	30.5	31.5	31.2	32.7	32.6	33.4
2013	34.7	36.3	35.3	32.5	33.4	32.3	30.6	29.3	30.4	32.5	33.1	32.9	33.2
2014	34.4	35.6	36.9	34.3	34.2	31.6	31.1	33.1	31.5	32.7	33.1	32.9	32.6