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# GENDER DIMENSIONS IN THE ADAPTATIONS TO CLIMATE VARIATION BY CASSAVA FARMERS IN THE AWUTU SENYA DISTRICT

SAMUEL SULEMANA MALCOLM MAHAMA

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# GENDER DIMENSIONS IN THE ADAPTATIONS TO CLIMATE VARIATION BY CASSVA FARMERS IN THE AWUTU SENYA DISTRICT

BY

SAMUEL SULEMANA MALCOLM MAHAMA

Thesis submitted to the Department of Geography and Regional Planning of the Faculty of Social Sciences, College of Humanities and Legal Studies, University Cape Coast, in partial fulfillment of the requirements for the award of Doctor of Philosophy degree in Geography and Regional Planning

APRIL 2019

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# DECLARATION

## Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature: .................................................. Date:..........................

Name: Samuel Sulemana Malcolm Mahama

## Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Signature:.................................. Date:........................

Name: ……………………………………………………………………………..

Co-Supervisor's Signature: ......................................... Date:........................

Name: ……………………………………………………………………………..



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## ABSTRACT

It has been predicted that, the overall impacts of climate change or variation on agriculture will be negative. Hence the significance of adaptation measures for poverty reduction, especially among crop producers has been emphasised. It has however been noted that although climate variation affects everybody, it is not gender neutral. Data on the nature and extent of adaptation to climate variation by cassava farmers from a gender perspective in Ghana are lacking. Therefore, the present study sought to explore the gender dimensions involved in the adaptation to climate variation on cassava production by farmers in the Awutu-Senya West District. Data used for the present study was obtained through both quantitative and qualitative methods with a sample size of 252 cassava farmers and key informants. Results showed clear gender dimensions with regards to climate variation adaptation strategies used by the farmers. Some of the challenges that constitute serious barriers to adaptations include, gender imbalance in formal education, poor access to weather information especially by female farmers, and the lack of interest for the use of improved cassava varieties by male farmers. It is therefore recommended that policy makers, and researchers adopt a gender sensitive approach in the sensitization of farmers on the how to appropriately identify issues relating to climate variability. They should also ensure that there is equity in the distribution of climate-smart resources and information among male and female cassava farmers and the need to use them.



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**KEY WORDS**

Awutu Senya West District

Cassava farmers

Climate variability

Coping and Adaptation strategies

Gender

Ghana



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# DEDICATION

To my wife, Breh Martha and my children



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## LIST OF ACRONYMS

| | |
|---|---|
| AAPCC | Africa Adaptation Programme on Climate Change |
| ADB | Africa Development Bank |
| AEAs | Agricultural Extension Assistants |
| AfDB | African Development Bank |
| AGDP | Agricultural Gross Domestic Product |
| C:AVA | Cassava: Adding Value for Africa |
| CBOs | Community Based Organizations |
| CCAFS | Climate Change, Agriculture and Food Security Program |
| CCS | Carbon Capture and Storage |
| CCSP | Climate Change Science Program |
| CIAT | International Center for Tropical Agriculture |
| CRI | Crop Research Institute |
| CSIR | Council for Scientific and Industrial Research |
| DfID | Department for International Development, UK |
| EPA | Environmental Protection Agency, Ghana |
| FAO | Food and Agriculture Organisation |
| FASDEP | Food and Agriculture Sector Development Policy, Ghana |
| FBOs | Farmer-Based Organisations |
| FM | Frequency Modulation |
| GAWU | Ghana Agricultural Workers Union |
| GDP | Gross Domestic Product |
| GIDA | Ghana Irrigation Development Agency |
| GMet | Ghana Meteorological Agency |
| GSS | Ghana Statistical Service |
| GTUC | Ghana Trade Union Congress |



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|---|---|
| IBM | International Business Machines Corporation |
| ICRAF | International Center for Research in Agroforestry |
| IFPRI | International Food Policy Research Institute |
| IPCC | Intergovernmental Panel on Climate Change |
| IQ | Intelligence Quotient |
| ISDR | International Strategy for Disaster Reduction |
| ISSER | Institute for Statistical, Social and Economic Research, Ghana |
| JHS | Junior High School |
| MEST | Ministry of Environment, Science and Technology, Ghana |
| MFCS | Multi-Features and Capacity-Enhancing Services |
| MIROC | Micro-industry Credit Rural Organization |
| MoFA | Ministry of Food and Agriculture, Ghana |
| MOWAC | Ministry of Women and Children's Affair |
| MSLC | Middle School Leaving School Certificate |
| NCCAS | National Climate Change Adaptation Strategy, Ghana |
| NCCPF | National Climate Change Policy Framework, Ghana |
| NGO | Non-Governmental Organisation |
| NWMLE | Network of Women Ministers and Leaders for the Environment |
| OSAGI | Office of the Special Advisor on Gender Issues and Advancement of Women |
| PECCN | Poverty, Environment and Climate Change Network |
| PUND | Programme des Nations Unies pour le développement |
| SHS | Senior High School |
| SLA | Sustainable Livelihood Approach |
| SPSS | Statistical Package for Social Science |



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|---|---|
| SRID | Statistics, Research and Info. Directorate |
| SSA | Sub-Saharan Africa |
| UN | United Nations |
| UNCCD | United Nations Convention to Combat Desertification |
| UNDP | United Nations Development Programme |
| UNEP | United Nations Environment Programme |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| UNFCCC | United Nations Framework Convention on Climate Change |
| USAID | United States Agency for International Development |
| USGCRP | United States Global Change Research Program |
| WAAPP | West Africa Agricultural Productivity Programme |
| WEDO | Women's Environment & Development Organization |
| WMO | World Meteorological Organization |



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# CHAPTER ONE

# INTRODUCTION

## Background to the Study

It is generally accepted that variation in the elements of the weather and climate (that is, climate variation) especially in rainfall and temperature have major effects on the agricultural industry worldwide. A growing season that receives little or no rainfall, coupled with high temperature and rapid evaporation is often associated with crop failure. Similarly, an extremely cold and windy nights, especially in the cold regions of the world, can wipe out entire orchards (Marlene, 2016; Adam, 2017).

Researchers claim that variations in the world's climate such as changes in average temperature, rainfall intensity, timing, and geographic distribution (of rainfall), increase in the frequency of extreme events such as drought and flood, have detrimental effects on agricultural productivity, biodiversity and ecosystems (Intergovernmental Panel Climate Change, 2007; Verner, 2011; Keane, Page, Kergna & Kennan, 2009; Nelson & Stathers, 2009)

Indeed, it has been predicted that, the overall impacts of climate variation on agriculture will be negative and will threaten global food security (Keane et al. 2009; Nelson, Rosegrant, Koo, Robertson, Sulser, Zhu,…& Magalhaes, 2009; Nelson, Rosegrant, Palazzo, Gray, Ingersoll, Robertson,..& Msangi, 2010). The Department for International Development (DFID, 2004) Report has indicated that, climate (change or variation) will have significant negative effects on agriculture, water availability, and on economic growth in Africa. The negative effect of climate change or variation on Africa's agriculture was emphasised by the IPCC Fourth Assessment Report (2007b),



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which observed that, the realisation of the African Green Revolution and its contribution to food security and economic growth in sub-Saharan Africa is threatened by climate variation.

Hence the Food and Agriculture Organisation (FAO, 2010b) has indicated that, agricultural development will be severely curtailed if the risks posed by variation in climate elements are not addressed. Agricultural production remains the main source of livelihoods for most rural communities in developing countries especially in Sub-Sahara Africa (SSA) in particular. Here, agriculture provides the source of employment for more than 60 percent of the population and contributes about 30 percent to the Gross Domestic Product (GDP) (Kandlinkar & Risbey, 2000). Thus, with continued adverse effects of climate variation, there will be decreased food production, increased in poverty among farmers and food insecurity. In some African countries, such as Ghana and Gambia, yields from rain-fed agriculture may be reduced by up to 50% by 2020 (IPCC, 2007a). It is even predicted that the declining crop yields in SSA will leave hundreds of millions of people without the ability to produce or purchase sufficient food (Chakeredza, Temu, Yaye, Mukingwa & Saka, 2009). As variation in climatic elements increases, the vulnerability of rural livelihoods and the ability of smallholder households to deal with its shocks and stresses increases. This means that the current practices may have to change substantially to allow adaptation and mitigation to the climate change or variation (Lioubimtseva & Henebry, 2009).

The IPCC (2007b) IV Assessment Report has stressed the significance of adaptation measures for poverty reduction, especially among crop producers. Adaptation measures are important to help vulnerable groups to effectively face



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extreme weather conditions (Adger, et al., 2003). Dankelman (2010) notes that although climate variation affects everybody, it is not gender neutral.
The impacts of climate variation, especially, hinder rural women's capacity to secure their livelihoods and pose yet new challenges to the agricultural sector by increasing poverty and reducing food insecurity.

Women and the youth constitute about 80 percent of smallholder farmers in Africa (Young, 2008). Consequently, the Bali Action plan (Banda, 2009) has suggested that if productivity in agriculture is to be improved, a search for climate-smart technologies and a study on the effects of climate variation on gender should be done (Banda, 2009).

Gender issues in policy debate on climate change and adaptations to climate variations were first raised at the United Nation's 2005 World Conference on Disaster which produced the Hyogo Framework for Action (2005-2015). The framework recommended that gender perspective should be integrated into all disaster risk management policies, plans, decision-making processes, and even those related to risk assessment, early warning, information management, education and training (ISDR, 2005).

Available research results indicate that not only does climate variation effect on agriculture impact differently on males, females youth and the aged but also the different gender groups (male, female, youth and aged) react differently to climate variation, and have different ways of coping and adapting to and mitigating its impacts (Ali, Deininger & Goldstein, 2014). The FAO (2011b), has noted that females and the youth play a key role in agriculture and make essential contributions to food security. But they have fewer entitlements in terms of rights, voice and access to decision making (Skinner, 2011). The



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gender disparity, stems from the socially and culturally defined roles of each gender group in agriculture that determine what a man or a woman or young adult may or may not grow, how they may pasture their livestock, where their fields should be, and who makes decisions at the household, local, national, and international levels (Goh, 2012).

Extreme variations in rainfall patterns within and between the years in Ghana have been confirmed by the World Bank (World Bank, 2010). Ghana's temperature projection from 2010 to 2050 by the World Bank (2010) indicates warming in all regions. Frequent of floods and extreme droughts in various parts of the country (for example, Northern, Central, Eastern, Greater Accra and Ashanti regions) are examples of the fact that temperature and rainfall patterns have changed (UNDP, 2012). In northern Ghana, erratic rainfall, increased incidence of pests and diseases both on crops and livestock, low crop yields and extinction of certain species of animals and plants, have been observed because of climate variation (Ghanaian Chronicle, 2011).

Variations in the climatic elements have been found to affect the production of food and cash crop such as cassava, cocoyam, cocoa, maize and rice (Sagoe, 2006; MOFA, 2013; MOFA, 2012). An analysis of yield data of various crops between 1993 and 2016 obtained from the Ministry of Food and Agriculture (MOFA, 2013) also indicates decreases in yield per hectare for yam, maize, rice, cassava and cocoyam (MOFA, 2012).

One of the important staple crops cultivated in Ghana is cassava which is the main source of carbohydrate and a regular income earner for most rural dwellers. This root crop is cultivated in eight out of the ten regions of Ghana; the exceptions are the Upper West and Upper East Regions (MOFA, 2005). It



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is cultivated by over 90% of the farming population in the country involving males females, youth and the aged (MOFA, 2014) and constitutes about 22% of the country's Agricultural Gross Domestic Product (AGDP) (MOFA, 2014). Its production is mainly rainfed, making it very susceptible to the adverse effects of climate variation.

Sagoe (2006), has observed that yields of cassava has been affected by climate variation. According to her, there was a positive correlation between cassava yields and the mean annual rainfall and temperature pattern. Sagoe (2006) indicated a yield gap of about 30% between the predicted and actual cassava yields in Ghana in 2005 which was attributed to climate variation.

The production and processing of the crop is most important in the Central Region, especially in the Awutu-Senya District, where both male and females are actively engaged in (MOFA, 2014).

Over the years, much of the research into agricultural and farming systems in Ghana has looked at soil, water and land management strategies, and technologies that make up the portfolio of climate-smart agriculture options for improving food crop production; but little or no effort has been made to explore the gender dimensions involved in the adaptations to climate variation by farmers in the production of cassava in order to secure their livelihoods (FAO, 2011a). It is therefore important to explore the gender dimensions of adaptations to climate variation by cassava farmers to augment previous and current research efforts aimed at improving cassava production in Ghana in the face of climate variation.



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**Statement of the Problem**

Rainfall and temperature variations have been found to affect the production cassava in Ghana (Sagoe, 2006; MOFA, 2013; MOFA, 2016). Cassava is an important food crop in Ghana. It is a food security crop and used in almost every home. It is also a cash crop and an important industrial raw material used by the pharmaceutical, confectionery and brewery industries. For example it used in the brewery industry for the production of beer (Ruut Extra Premium Beer by Guinness Ghana Brewery Limited) providing jobs and income for cassava value chain actors which include farmers (MOFA, 2013: Kwahu, 2014). But the variations in the climatic elements are affecting its production which invariably affects those who depend on it for their livelihood (Sagoe, 2006).

Abubakari and Abubakari (2015), have indicated that, climate variations is responsible for the current average of 13.8mt/ha of harvested cassava instead of an achievable yield of 48.70mt/ha in Ghana. Asante and Amuakwa-Mensah (2015) have also stated that rice, and root and tuber crops (especially cassava) production are expected to be low as a result of climate variation. A study by Sagoe (2006) has observed the impacts of climate variation on root and tuber crops in Ghana as being reductions in yields of cassava. Consequently, the author has projected that cassava production or yield is expected to reduce by 3%, 13.5%, and 53% in 2020, 2050, and 2080 respectively.

The above has led MOFA and the research community in Ghana to introduce a number climate resilient cassava varieties and technologies to improve and increase yields by about 40%. However, there have not been any appreciable increase in yields as evident in Figure 1 (MOFA, 2016; West Africa



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Agricultural Productivity Programme (WAAPP), 2016).

The percentage increase in yield following the introduction of the improved varieties and the associated climate smart technologies between 2009-2011 was 10.5%, (Figure1), which is far below the expected increase of over 40% (WAAPP, 2016).

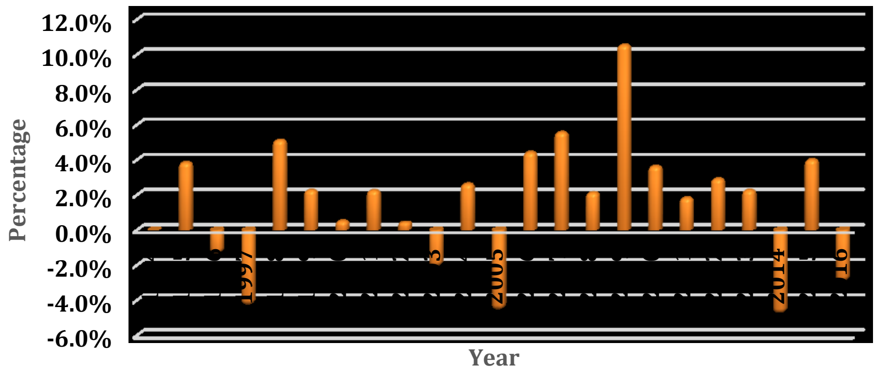


*Figure 1*: Percentage change in cassava yields in Ghana from 1994 to 2016

Source: SRID, Ministry of Food and Agriculture (2016)

The insignificant impact of the climate smart technologies on cassava yields has been attributed mainly to poor uptake and adaptability of the improved cassava technologies by farmers (Acheampong, et al, 2017).

Acheampong, et al., (2017) have observed the poor acceptance of improved varieties and climate-smart technologies and opined that the diffusion of the information and technologies were not gender-based. But Dzah (2011) has recognized the importance of perception of gender groups as important factor in decision making. Thus if climate variation research and interventions are to be targeted to men, women, youth aged farmers, there is the need to understand how each gender group perceive and respond to climate variation in order to devise adaptation strategies that each gender group prefers.



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In the Ghanaian agricultural system gender issues have been observed, for example, although women are important food producers and providers in Ghana, their views and interest are seldom integrated into discourses on food production (Rodenberg, 2001). According to Rodenberg (2001), women in Ghana are still considered as recipients of development, hence in comparison with men, women's interests are less prioritised in government policies. Gender mainstreaming therefore appears not to have been effectively institutionalised in the country's development planning process. Yet the Food and Agriculture Organization (2011a) report on the state of food and agriculture estimates that more than one hundred (100) million people could be lifted out of poverty worldwide if women have the same access to information and resources as men. In view of this, adaptation measures should include the preference of all the various gender groups' while finding the right measures to combat adverse effects of climate variation on food production.

Awutu Senya district in Ghana is a major cassava producing area. It produces an average of 414,585 metric tons of cassava per annum (MOFA, 2014). That figure represents about 3% of the national annual production of the crop. The District hosts the Ayensu Starch Factory which uses cassava as the only primary raw material for the production of starch. With the establishment of the Ayensu Starch Factory and the growing need of cassava as an important staple food-crop in Ghana, the demand for the crop has increased (WAAPP, 2014). This has brought positive implications on the production capacity of the farmers, but the variation in the climate has negatively affected their activities.



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The climatic data of the district between 1984 and 2014 indicated that rainfall was erratic and decreased, while temperatures increased (see Figures 9, 10 and 12). The unpredictable nature of the climate over the three decades has affected cassava yields in the study area (WAAPP, 2010). According to the WAAPP (2014), Ghana Statistical Service (2014) and MOFA (2014), over 90% of the farming population are cassava farmers with 40% being women, 60% men, over 30% youth and 20% aged. There are strong traditional beliefs, norms and cultural practices associated with farming in the district such as men having full ownership of land by way of inheritance, boy child education is a priority over the girl child and decisions about farming activities are made for women and the youth by the male head of the family (WAAPP, 2014).

In spite of the active involvement of large numbers of men, women, youth and the aged in cassava production in the area, little or no study has been done on how male and female farmers (men, women, youth and aged) differently mitigate risks and adapt to challenges brought about by climate variation. Much of the research into agricultural and farming systems in Ghana has looked at soil, water and land management strategies, and technologies but little has been done to explore the gender dimensions involved in the adaptations to climate variation by farmers in the production of (FAO, 2011b). It is on this premise that this research is founded to supplement previous efforts aimed at improving cassava production in Ghana in the face of climate variation. The expectations are that the adverse effects of climate variation on cassava production in the Awutu Senya district has some gender implications.



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**Objectives of the Study**

The main objective of the study was to explore the gender dimensions in the adaptation to climate variations by cassava farmers in the Awutu-Senya District.

The specific objectives were to:

1. explore the:
    a. gender perceptions on the causes of climate variation among cassava farmers in the Awutu Senya district;
    b. gender perceptions of the effects of climate variation on cassava production in the study area;
2. explore the gender dimensions of the factors influencing vulnerability to the adverse effects of climate variation among cassava farmers in the study area;
3. identify which gender is more vulnerable gender to the adverse effect climate variation;
4. explore the gender dimensions of the effects of climate variation on cassava production in the district;
5. identify the coping and adaptation strategies employed by each gender, and;
6. suggest further research into gender and agriculture as a whole

The study was guided by the following questions:

1. How have the climatic element (rainfall and temperature) in the district varied at least during the past 30 years?
2. What does climate variation mean to the cassava farmers in the Awutu Senya District?



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3. What is the perception of each gender group of climate variation?
4. Which gender do the farmers perceive to be more vulnerable to the adverse effects of climate variation in the study district?
5. How does each gender group perceive climate variation as a major controlling factor in the production of cassava?
6. What coping and adaptation strategies does each gender group use to contain the adverse effects of climate variation on cassava production in the district?
7. What are the gender dimension involved in the adaptation to climate variation by cassava farmers in the district?
8. How can the existing coping and adaptation strategies be strengthened from gender point of view?

The work was based on the hypothesis that:

1. $H_0$: there are no gender differences in the vulnerability of cassava farmers to climate variation

   $H_1$: there are gender differences in the vulnerability of cassava farmers to climate variation
2. $H_0$: there are no gender dimensions in the adaptation strategies used by cassava farmers to combat climate variation effects
3. $H_1$: there are gender dimensions in the adaptation strategies used by cassava farmers to combat climate variation effects

**Significance of the Study**

Due to the serious attention given to climate variation at the international level, debates concerning gender and the involvement of both men



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and women in finding solutions to the effects of climate variation on the socio-economic activities have arisen (Babugura, 2010). It is believed that men and women are differently affected by climate variation impacts due to gender inequality (Rose, 2007; Commission on the Status of Women, 2008; Carvajal, Quintero & Garc´ıa, 2008; Brighton Institute of Development Studies, Brody, 2008). At the 52nd Session of the Commission on the Status of Women (2008), it was revealed that the Bali Action Plan had already suggested that to effectively address the impacts of climate change or variation, one has to think of gender dimensions in mitigation and adaptation methods, capacity building, new technologies, and financing. The United Nations Framework Convention on Climate Change (UNFCCC, 2008) has also stressed on the need to include gender-specific recommendations in its conference documents. Hence, identifying gender dimensions in the adoption of effective climate variation adaptation strategies (to enhance food security), has now become relevant.

Therefore, to cope with the adverse effects of climate variation, agricultural systems must be resilient and able to adapt to variation (Banda 2009). The Ghanaian agriculture sector is highly vulnerable to the effects of climate variation which adversely affects crop production thereby creating serious challenges to food security. Both male and females (women and men youth and aged) play significant roles in safeguarding food security in Ghana. Hence, the respective impacts of climate variation on their farming activities and how each gender group adapt to the variation need to be well understood to ensure that interventions meant to enhance increased productivity in food crop production are gender responsive.



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Awutu-Senya District, is a known cassava producing area in Ghana where both males and females are actively involved in the production. The cultivation of the crop faces a lot of challenges due to variation in the climatic elements in the district. Hence studies on the mechanisms for improving resilience to climate variation in order to boost the production of the crop, especially from gender perspective, has to be recognized as an important area of focus. Currently, there is little knowledge on how male and female farmers adapt to the effects of climate variation on cassava production in Ghana. It has therefore become necessary to understand the interrelation between climate variation, gender and agriculture. By throwing light on these issues, it is hoped that the study will bring to the fore gender dimensions associated with agriculture in Ghana.

The gender dimensions to be realised and the lessons to be learned in terms of the adverse effects of the variation, will help policymakers, development practitioners, and researchers to see how marginalised groups could gain equitable access to resources and climate-smart information that would allow them to make better decisions on how to adapt to climate variation.

With the appropriate gender sensitive adaptation strategies, it is hoped that yields of cassava will increase and will help to safeguard food security in Ghana. Finally, it is hoped that the finding of the present study will contribute to solving some of the problems cassava farmers in the country face as a result of climate variation impacts.

**Delimitations**

The scope of this study was limited to the Awutu Senya District which covers four communities (Awutu Breku, Senya Beraku, Bawjiase and Bontase).



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The focus of the present study was to assess the gender dimensions in the adaptation strategies used by the cassava farmers in the study area in order to combat the adverse effects of climate variation on cassava production. In doing so, the study evaluated the perceptions of the cassava farmers about climate variation and the effects of the variations on cassava production from gender perspective. Views of farmers were sought on which gender is more vulnerable to climate variation in the study area. The key variables used for the analysis were gender, perceptions, vulnerability, effects of climate variation and adaptation strategies used by the farmers. Gender was evaluated against perceptions of farmers about climate variation, the effects of climate variation on farmers, vulnerability to climate variation and finally the adaptation strategies used by the farmers. The sample unit for the study was cassava farmers whose views on the problem under investigation were obtained using structured questionnaire and analysed based on gender. Questions were both close-ended and open-ended with the option of explaining to respondents questions that were not properly understood and also to control and direct responses towards the objective of the study.

The reason for choosing this topic was to highlight the gender differences with regards to the effects of climate variation on cassava farmers, and gender related adaptation strategies used by cassava farmers in combating the effects of the variations.

**Limitations**

The work was based on a sample of cassava farmers in the Awutu Senya District. The target population was farmers who cultivated cassava as their main farming occupation. Another limitation of the study was that, aspects of the



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sampling procedure was based on convenience in terms of the sampling unit and sample size selection with partial randomisation. As a result, there was some bias associated with the sampling procedure, which further limited the extent of application of the results.

In order to address with the effect of using a sample, the sample size was selected within a 95% confidence interval using Krejcie and Morgan (1970) model. Randomisation was also introduced to minimize the element of bias as a results of the convenience sampling.

Gender was a key issue, thus while trying to ensure a large enough sample, there was also the problem of ensuring fairness in the representation of each of the gender groups. This proved to be a challenge because there were more males involved in the cultivation of cassava in the study area than females. However, the use of cross-tabulation and within gender analysis helped to reduce the effect of the gender imbalance on the quantitative results.

The results of this study are limited by the fact that gender roles and responsibilities vary from one culture to another, to society and geographic locations of the country and change over time.

**Organisation of the Study**

The thesis consists of seven chapters. Chapter One presents the background or the problem that motivated the study. It describes the purposes of the study and states the research questions underpinning the study with the associated hypotheses. It goes further to state the significance of the study, and indicates the delimitations and limitations of the study.

Chapter Two reviews the relevant literature on the effects of climate variation on agriculture and on farmers with particular reference to Ghana. It



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begins with the definition of terms, key concepts and underpinning theories. It references from literature how climate variations creates different impacts for male and female farmers, and it assesses gender dimensions of the vulnerabilities to the effects of climate variations. The chapter also explores the link between gender differentiated effects, vulnerability and adaptations to climate variations. The chapter then highlights five models that were used to assess the gender-based impacts, vulnerability and the adaptation to climate variations. It then describes an integrated conceptual framework that overcomes the weaknesses in the models reviewed, and which is deemed appropriate for the analysis and evaluation of the data collected for the present thesis.

Chapter Three describes location and the climatic characteristics, the population structure, and the livelihood opportunities available of the study area. The research design and methodology are also presented in the Chapter. The research procedure that includes data collection process, the sampling procedure, the target population and the data collection instrument are all described. The chapter further outlines the methods used in the data processing and analysis and describes the relevant statistical tools and the strength and limitations of the instruments employed. It ends with a pretest that was conducted before the actual survey.

Chapters Four presents the analyses of the data. It examines the demographic and socio-economic characteristics of the respondents while Chapter Five describes the trend in the key climatic elements that are rainfall and temperature of the study area. The Chapter also presents the perception of farmers about climate variations from gender perspective and then gives an account of the factors influencing vulnerability and the gender perspective of



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these factors. It ends with the presentation of more vulnerable gender together with the perception of farmers on why one gender was considered more vulnerable. Chapter Six presents the accounts on gender dimension of the effects of climate variations on cassava production and the adaptation strategies used by men and women to combat the adverse effects of variations in the climatic elements on their livelihood with the associated gender dimensions. Chapter Seven presents the summary of the study, conclusions drawn and some key recommendations.

**Summary**

This chapter has provided the background and justification for the study. It has stated the research problem and outlined the main research objectives. The envisaged benefits of the research to the stakeholders who are farmers, researchers, development practitioners and policy makers have been highlighted.



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# CHAPTER TWO

# REVIEW OF LITERATURE

## Introduction

This chapter reviews the relevant literature related to gender, climate variations, vulnerability to climate variations, and adaptations to climate variation and the theories that underpin these concepts. The chapter begins with definitions of terminologies used in this. It also review literature of related concepts and the role they play on food crop production and on agriculture in general and Ghana for that matter. Relevant theories that informed the study are reviewed alongside related concepts and sets the stage for the assessment of gender dimensions in the adaptation to climate variations by the cassava farmers in the Awutu-Senya District. This is then followed by some empirical studies and the review of theoretical frameworks that formed the basis for the evolved conceptual framework for the present studies.

## Definitions of Terminologies

There are several definitions of terms such as climate change, climate variability, climate variation, gender, vulnerability, adaptation, coping, and resilience. In this thesis, working definitions have been adopted and applied with justifications.

### *Gender*

Gender has been variously defined to include socially constructed differences between male and female, and the biological characteristics of male and female (Babugura, 2010).

The Cambridge International Dictionary of English (1995) says that "gender is the physical and/or social condition of being male or female…"



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Hence in some societies, gender roles are fixed. The Oxford English Dictionary (2010) says that gender is “the state of being male or female”. Babugura, (2010) used the term gender to define human groups based on social factors. He differentiated between the biology of being male or female and “gender” to denote the role that culture assigns through socialisation to each individual. The FAO (2011a), defined gender as not necessarily to male and female, but to masculine (manly, brave, strong, muscular, well built) and feminine (womanlike, soft, gentle, tender, delicate, weak), that is, to qualities or characteristics that society ascribes to men and women.

In all the definitions of gender, “sex” (male and female) has been used as the differentiating factor in order to determine if an individual or group is vulnerable or disadvantaged because of established gender norms by the society except the FAO (2011a), which defined gender as not necessarily to male and female, but to masculine and feminine. Even with the FAO (2011a) definition, the attributes of masculine still referred to manly features and behaviour while feminine referred to womanly features and behaviour. Within the categorization of males and females are; men women, youth (children and young adults), aged and people living with disabilities.

The present thesis adopts all the definitions that emphases on the social attributes and opportunities associated with being male and female and how these impacts different social relations in the study area. Gender in the present study then connotes what is allowed or disallowed to an individual, opportunities and disadvantage ascribed to a farmers which are determined by established social and cultural norms and by public and private institutions because he/she is male or female or masculine or feminine. It was observed that,



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of all the respondents interviewed none of the females exhibited masculine characteristics or behaviour also none of the males demonstrated a feminine behavior. Hence the gender norms still applies to male and female farmers in the study area. Since the focus of the present study is on farming, children and the youth below the 18 years are excluded from the categories of gender.

***Gender dimension***

The European Commission (2012) referred to gender dimension" as integrating sex and gender analysis into research. That is ways in which the situation and needs of, and challenges facing, women and men, girls and boys differ, with a view to eliminating inequalities and avoiding their perpetuation, as well as to promoting gender equality within a particular policy, programme or procedure (European Commission, 2012)

***Climate variation, variability and change***

Long term-average changes in the weather, collectively make up the climate. However, there is evidence of variations or fluctuations in the climate itself (Acheampong, 2009). Whereas climate is the average condition of the weather elements for a period of time climate variations are short-term changes that occur monthly, or seasonally in the elements (Acheampong, 2009: Savitsky, 2017). In this study, the term climate variation has been used with reference to Acheampong (2009) and Savitsky (2017) definition.

Fluctuations or variations may occur around the long-term average conditions of the atmosphere without causing the long-term average itself to change. This phenomenon is climate variability. If for example, within a 30-year period the short-term value of say rainfall or temperature rose above and



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fell below the long-term average values from one month or season to the other, we can talk of climate variability (Acheampong, 2009).

Climate change in IPCC usage refers to a change in the state of the climate that can be identified (for example using statistical tests) by changes in the mean and or the variability of its properties that persists for an extended period, typically decades or longer. It refers to any shift in climate over time, whether due to natural causes or as a result of human activity (IPCC, 2007a).

***Vulnerability***

According to the IPCC (2007b) definition, vulnerability with regards to climate variations or variability is “the degree to which a system (natural or human) is susceptible to, or unable to cope with adverse effects of climate variations. Vulnerability is then a function of the character, magnitude, and rate of deviations to which a system is exposed, its sensitivity, and adaptive capacity”. The definition of the IPCC (2007a) specifically highlights three components of vulnerability in the context of exposure to variations, sensitivity and adaptive capacity. Exposure represents the background climate conditions and stimuli against which a system operates, and any deviations in those conditions. Sensitivity reflects the responsiveness of a system to climatic influences, and the degree to which changes in climate may affect it in its current form. Sensitivity of a system to climate variation in the present study means the degree to which a system is affected, either adversely or beneficially, by climate variations or variation (IPCC, 2007b).

***Adaptation***

The present study adopts the IPCC (2014), Annex II: Glossary definition of adaptation as the process of adjustment to actual or expected climate and its



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effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate variation and its effects (IPCC, 2014). According to IPCC (2007b), various types of adaptations can be distinguished. These include anticipatory, autonomous and planned adaptations. The report defined anticipatory adaptation as the adaptation that takes place before impacts of climate variation are observed, while autonomous adaptation is defined as adaptation that does not trigger off a conscious response to climatic stimuli, but the response is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Planned adaptation is referred to by the IPC (2007a) report as the adaptation that results from a deliberate policy decision based on an awareness that conditions have changed or are about to change, and that action is required to maintain, or achieve a desired state.

***Adaptive capacity***

Adaptive capacity is defined by the IPCC (2007b) as "the ability of a food production system to adjust to climate deviations in order to moderate potential damages, to take advantage of opportunities, or to cope with any consequences". Adaptive capacity therefore comprises adjustments in both behaviour and in resources such as technologies (Adger, et al., 2007). The present study adopts the definition by the IPCC (2007b) and Adger et al (2007) because they allow broad conceptualisation of farming communities, and the resources they draw upon in adapting to climate variations.



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***Resilience***

Climate resilience can generally be defined as the capacity for a socio-ecological system to: (1) absorb stresses and maintain functions in the face of external stresses imposed upon it by climate deviations, and (2) adapt, reorganize, and delve into more desirable configurations that improve the sustainability of a system, leaving it better prepared for future climate change or variation impacts (Folke, 2006; Adger, et al., 2003; Nelson, Adger, & Brown, 2007). For example, resilience can be said to be present in situations where major changes and variation in the climate (such as drought) result in insignificant loss of crop yield in a particular community (Simelton, Fraser, Termansen, Forster, &Dougil, 2009).

***Coping Capacity***

The capacity of a system to adjust to a natural hazard is determined by the ability of the system to tolerate disturbances, moderate potential damage, take advantage of opportunities, and adapt to the consequences (Gallopin, 2006). Coping capacity and adaptive capacity are often used with reference to timescale. Adaptive capacity is linked to long-term strategies, whilst coping capacity may include short-term strategies (Smithers & Smit, 1997). In this thesis, coping capacity concerns the short-term strategies taken by farming households and communities to counteract the immediate negative impacts of climate variation (Campbell, Barker & Mcgregor, 2011).

***Food security***

Several definitions have been proposed for food security over the years. The present study recognizes the United Nations' Committee on World Food Security (1974) definition as the condition in which all people, at all times, have



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physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2006)

***Drought***

Drought, according to Acheampong (2009), has two meanings: conceptual and operational. The conceptual meaning helps to understand a phenomenon and its effects. For example, drought is seen by many as a protracted period of precipitation deficiency that causes extensive damage to crops, resulting into loss of yield.

The operational meaning on the other hand helps to identify the beginning, the end, frequency, duration and the degree of departure from the average precipitation over some period of time. With the two in mind, Aheampong (2009) identifies several definitions that are meteorological, agricultural, hydrological and socio-economic drought. The present thesis is concerned with meteorological, agricultural, and socio-economic droughts. Meteorological drought is often defined as a period of substantial diminished rainfall in comparison to a normal or average amount. Because the atmospheric conditions that causes deficiencies of precipitation are region-specific, definitions of meteorological are region region-specific.

Agricultural drought occurs when there is inadequate soil moisture to meet the needs of particular crop at a particular time.

Hydrological drought refers deficiencies in the surface and subsurface water supplies. It refers to the persistently low discharge and/or volume of water in streams and reservoirs lasting months or years, and socio-economic drought associates the supply and demand of some economic goods with elements of



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meteorological, hydrological, and agricultural drought. It occurs when physical water shortages start to affect the health, well-being, and quality of life of people, or when drought starts to affect the supply and demand of an economy.

## Underpinning Theories and Concepts

### *Theories underpinning gender development*

Gender theory originates from ethnographic observations and anthropological studies of what is considered to be male and female in different cultures and eras. Gender theorists discovered that the different roles and norms of men and women, are in fact socially determined. This means that gender is a social and cultural construction created by the society one lives in. Four theories that underpin gender development and found to be relevant to the present study are the psychodynamic theory by Sigmund Freud, symbolic interactionism by George Herbert Mead, the social learning theory by Fagot, and the standpoint theory by MacKinnon. (Scott & Linda, 2014).

### *Psychodynamic theory*

Psychodynamic theory has its roots in the work of Viennese Psychoanalyst, Sigmund Freud. This theory sees the role of the family, the mother in particular, as crucial in shaping one's gender identity. Boys and girls shape their identity in relation to that of their mother. Because girls are like their mothers biologically they see themselves as connected to her. Because boy are biologically different or separate from their mother, they construct their gender identity in contrast to their mother. Thus since fathers have been largely considered in the social setting as being superior over the mothers, the children begin to form the perceptions of what is expected of a male and of a female.



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**Symbolic Interactionism Theory**

Symbolic Interactionism by George Herbert Mead, is based specifically on communication. Although not developed specifically for use in understanding gender development, it has particular applicability here. Since gender is learned through communication in cultural contexts, communication is vital for the transformation of such messages. When young girls are told to “sit up straight like a lady” or boys are told “gentlemen open doors for others,” girls and boys learn how to be gendered (as masculine and feminine) through the words (symbols) told to them by others (interaction). In consonance with this theory, Boateng, Adomako-Ampofo, Flanagan, and Yakah, (2006) have observed that in most Ghanaian societies and culture girls are taught to look up to men and boys as stronger, wiser, and more responsible and boys are socialized to lead and control women at very early stages of their development and these persist up to adulthood.

***Social Learning theory***

Social Learning theory is based on outward motivational factors that argue that if children receive positive reinforcement they are motivated to continue a particular behavior. If they receive punishment or other indicators of disapproval they are more motivated to stop that behavior. In terms of gender development, children receive praise if they engage in culturally appropriate gender displays and punishment if they do not. When aggressiveness in boys is met with acceptance, or “boys will be boys” attitude, but girls’ aggressiveness earns them little attention, the two groups’ children learn different meanings for aggressiveness as it relates to their gender development. Thus, boys may continue being aggressive while girls may drop it out of their repertoire. As



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Marinova (2003) ague, socialization processes and belief systems influence adherence to particular gender stereotypes and patterns of behaviour. For example there are various traditions in Ghana that promote stratification of gender roles and are reinforced by passing these traditions from one generation to the next (Boateng et al., 2006). Pullen and Knights (2007) opine that individuals authenticate their gender when they conform to the conventional norms of the society.

In conforming to the norms, authentic women must be feminine, passive, and subordinate, while authentic men must be masculine and aggressive, and possess an excess of confidence (Pullen & Knights, 2007). As Boateng et al. (2006) argue, male characteristics that are respected and encouraged in Ghana include virility, strength, establishing authority, power and leadership qualities, the ability to offer protection and the ability to bear physical and emotional pain. Thus the knowledge children acquire and approval of their actions through socialization further entrenches the gender difference that exist between men and women as they are likely to hold these views throughout their lives and passé them on.

***Standpoint theory***

Standpoint theory places culture at the nexus for understanding gender development. Theorists such as Collins and Harding recognize identity markers such as race and class as important to gender in the process of identity construction. An obvious fact that, many cultures, are organised hierarchically. Some groups of people have more social capital or cultural privilege than others. For example in many Ghanaian traditional settings, men are the decision



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makers, the owned more properties and boy child education is preferred over girls child (Boateng et al. 2006; Marinova, 2003)

One way of overcoming gender challenges is gender mainstreaming. Gender mainstreaming is a strategy to promote gender equality. Studies have shown that gender mainstreaming develops organizational and procedural changes (Caglar, 2013). Gender mainstreaming can be implemented by creating and building up a gender expertise within an organization (Caglar, 2013). Some scientists say that gender mainstreaming not only provide a focus on the inequality between men and women, but it also ensures that women´s rights are addressed. It enlightens situations where the needs of men and women are different, it also ensures that each gender group would have equal access to the solutions (Alston, 2014).

**Concept of Gender**

All the three theories have shown gender to have a social and cultural background. According to the theories, individuals' identify with their gender right from infancy at the household level as to whether he or she is a male or female. Then through socialization roles, responsibilities, values, rights opportunities and expectations are assigned to each gender which are learnt over time and passed on to generations for sustenance. The theories also indicated the other aspects of gender which did not necessarily referred to male and finale and the associated opportunities and disadvantages, but referred to gender with respect to cast, ethnicity and region. In all cases, gender determines power, opportunities, rights and responsibilities.

The term gender was first used by John Money in 1955 to refer to sexual attributes of people (Babugura, 2010). He used the term to define human



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groups based on social factors. John Money wanted to differentiate between the biology of being male or female and "gender" to denote the role that culture assigns through socialisation to each individual. Since then, the term has been widely defined to include the socially constructed differences between male and female and to their unequal power relationships. (Babugura, 2010; International Federation of Red Cross and Red Crescent Societies, 1999; Commission on Gender Equality, 2000; United Nations, 2002; United Nations Educational, Scientific and Cultural Organization, 2003; Annecke, 2002). Thus, gender is a socially constructed definition based on the characteristics of male and female. It is determined by the conception of task, functions and roles attributed to males and females in society, in public and in private life (FAO, 2011a). In other words, when individuals or groups do not "fit" into the established gender norms, they often face stigmatization and social discriminatory or social exclusion, all of which adversely affect the individual or groups.

Perceptions of gender are deeply rooted, vary widely both within and between cultures, and change with time. But in all cultures, gender determines power and resources of females and males (FAO, 2011a). In most societies, there are differences and inequalities between women and men in assigned responsibilities, activities that should be undertaken, access to and control over resources, as well as decision-making opportunities. Gender is therefore a part of the broader socio-cultural context (UN, 2002). Like race and ethnicity, gender functions as an organising principle for society because of the cultural meanings given to being male and being female. In Ghanaian societies there are clear patterns of "women's work" and "men's work," both in the household and



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in the wider community as espoused by the social learning theory. There are also cultural explanations of why this should be so. However, the patterns and the explanations differ among societies, and they change over time (Dako-Gyeke & Owusu, 2013).

**Concept Gender Dimension**

The European Commission, referred to gender dimension" as integrating sex and gender analysis into research. They suggested that in research concerning adaptability to extreme environmental conditions such as extreme weather events, respondents should be classified based on the situation, the needs of, and challenges facing males and females. Thus gender dimensions in the present study therefore implies considering disparities in opportunities and rights that deepens one gender's vulnerability and lessens its capacity adapt to extreme climatic events with a view of eliminating these disparities. It also involves assessing the different needs and ways of adapting to climate variation by male and female cassava farmers in order to promote equity in gender sensitive resource that will facilitate effective adaptation. In addition, it involves promoting gender equality within a particular policy, programme or procedure. The gender dimension is sometimes referred to as the 'gender perspective'. Scientists have argue that a gender perspective on society is important to ensure equality between men and women (Pansiello, & Pastor, 2015).

**Concept of Climate Variation**

Climate variations has moved from being a hypothesis to a reality. This is confirmed by the fact that global average surface temperature has increased by 0.6$^{o}$C±0.2$^{o}$C since 1900 (IPCC, 2001). The Fifth Assessment Report from



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the IPCC (2013), for example, has found that on the average global temperatures increased about 0.85°C from 1880 to 2012.

While climate tends to evolve or change slowly, shorter-term fluctuations on monthly or seasonal time scales occur in the climate. Such phenomena are called climate variations (Savitsky, 2017: Acheampong, 2009).

Whereas climate variation refers to shorter-term fluctuations on monthly or seasonal time scales that occur in the climate, Climate Variability" is often used to denote deviations of climatic statistics over a given period of time (for example a month, season or year) when compared to long-term statistics for the same calendar period. Climate variability is measured by these deviations, which are usually termed anomalies. (WMO, 2007).

**Gender and Climate Variations**

According to Dankelman (2010), climate variation impacts are not gender neutral. This implies that the burden of the effects of climate variation on livelihoods can be evaluated according to gender. As such, the degree to which men and women are affected by climate variation can be considered as a function of their gender. For example, Brody, Demetriades and Esplen (2010) and Nelson (2010) have observed that women and men are not affected by the impact of climate variations in the same way because of the existing gender inequalities enshrined in formal and informal institutions in the society. Women's traditional roles as the primary users and managers of natural resources, primary caregivers, and labourers engaged in labour, mean that they are involved in, and are dependent on livelihoods and resources that put them more at risk to the impact of variation in climatic elements (Brody et. al. 2008).



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Gender and environment theorists agree that women´s concern for the environment is not at all based on female biological characteristics, but is rather more likely based on social conditions given by society (Ergas & York, 2012). These social conditions stand in correlation to nations, cultures, religions, ethnicities and topographies. In other words, the female concern for the environment is a result of the social environment that influence the gender roles (Ergas & York, 2012).

A gender perspective on climate variation enlightens the differences between how men and women are affected by climate variation, of how their views and concerns on climate variation differentiates. A gender perspective on climate variation also enlightens the inequality of decision making processes.

**Climate Variation, Agriculture and Gender**

The effects of climate variation are well documented by the IPCC (2001; 2007a), the United States Agency for International Development (2009), the United Nations Development Programme (2009) and the World Meteorological Organisation (WMO, 2007). While the effects are global, they vary across regions, time, classes of people, income, occupations and between males and females.

Agriculture and climate variation are closely linked. Crop yield (in the absence of irrigation) and water use, as well as soil fertility are directly affected by variability in climatic elements. Continued changes in the frequency and intensity of precipitation, heat waves, and other extreme events impact negatively on agricultural production. The current hydrologic cycle which shows more frequent and intense droughts and floods in many agricultural regions of the world, reduces yields and at times even destroys crops. Warmer



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temperatures make crops grow more quickly in cold temperate climates but reduce yields in the tropics (CCSP, 2008).

There are indications that higher concentrations of $CO_2$ are increasing yields of some crops. For example, yields of wheat and soybeans increase by about 30% or more under a doubling of $CO_2$ concentrations. The yields for other crops, such as corn, exhibit a much smaller response (less than 10% increase) (CCSP, 2008). However, according to CCSP (2008), the same climatic factors may counteract the potential increases in yield for other crops. For example, if temperature exceeds some crops' optimal level, or if sufficient water and nutrients are not available, yield increase may be reduced or reversed. Weeds, pests and fungi thrive in warmer temperatures, wetter climates, and in increased $CO_2$ levels. The proliferation of weeds, pests and fungi reduce crop yield because of intense competition for nutrients. This leads to increase in the use of pesticides and fungicides. But increased use of these chemicals negatively affects human health.

In 2005, nearly 2.5 billion people (about half of the economically active population) in developing countries relied on agriculture for their livelihood according to the IFPRI (2009). As such any negative effects of climate change or variation on agriculture could act as a 'risk multiplier' in terms of food insecurity, in some of the poor countries of the world (IFPRI, 2009). Results from an agricultural model by the IFPRI (2009) suggest that agriculture and human well-being will in future, be negatively affected by climate change or variation. This corroborate with earlier research results by IFPRI (2009) and Human Development Report (2007/2008) that state that:



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- in developing countries, variation in climatic elements will cause yield declines in the most important staple and cash crops;
- climate variation will have varying effects on yields of irrigated fields across regions;
- climate variation will result in additional price increases for the most important agricultural crops; higher feed prices will result in higher meat prices and these will cause a reduction in meat consumption and substantial fall in cereal consumption; and that
- calorie availability in 2050 will actually decline relative to the 2000 levels throughout the developing world as a result of variability in climatic elements.

Evidence that climate variation impacts on agriculture and human well-being as given by the IFPRI (2009), has been corroborated by the Human Development Report, 2007/2008 (IFPRI, 2009). The report stresses on five-central problem fields in which climate variation may intensify poverty. These are:

i. Declining crop yields (up to 50% anticipated for Africa).
ii. Declining water availability (up to 1.8 billion additional people affected).
iii. Migration and flight of hundred million people due to exposure to climate related disasters.
iv. Danger to ecosystems and food security.
v. Spread of diseases and infections (with up to additional 400 million people being exposed to malaria).



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Adverse effects of climate variation on agriculture have implications for those who depend on the sector for their livelihood. For example, excessive rains, or drought can cause poor yields or total crop failure. This could deepen poverty among peasant farmers. Incidence of hunger and food insecurity will also increase. The IPCC (2007a) IV Assessment Report indicates that, climate change impacts will be most felt in Africa because of the continent's heavy dependence on agriculture. This has been corroborated by the African Development Bank (AfDB, 2009) report which indicates that an estimated 70% of Sub-Sahara Africa's population relies on subsistence and rain-fed agriculture with women constituting the majority. This makes women more exposed to the impacts of climate variation. The impact especially affects rural women's ability to secure their livelihoods since they depend largely on subsistence agriculture.

There are several linkages between gender and agriculture mostly in the developing countries. The linkages come from socially and culturally defined roles of women and men in agriculture. The gender factor in agriculture affects access to, and the control over resources. Ester, (1970) has distinguished between 'male farming system' and 'female farming system', where it is said that male farming system is characterised by high levels of agricultural wage labour, land inheritance through male lines, and low presence of women in the field due to strict norms on female seclusion that eventually results in women concentrating on tasks within the house.

Female farming system is characterised by family farming, low levels of wage labour, bilateral inheritance practices, communal ownership of land with usufruct rights for female members and high percentage of female family



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labourers. Women in this system play a major role in food production, have greater freedom of movement, and are active in trade and commerce (Ester 1970).

Rural employment studies have shown that in much of Africa, women are the main producers of food crops, while men are engaged in commercial farming (FAO 2010b). Nonetheless, in some cases (for example, Burkina Faso, Tanzania and Zambia), both male and female farmers grow food and commercial crops. However, men often move into traditionally female farming if such activities become more productive or profitable as it occurs in The Gambia, Tanzania, Uganda and Zambia (Goh, 2012).

**Effects of Climate Variation on Agricultural Sector in Ghana**

According to the IPCC (2001), the impact of climate (adverse) variation is going to be stronger in many developing countries in Sub-Sahara Africa, especially in the agro-based economies such as Ghana, where over 60% of the labour force rely on agriculture and its related activities (Dzah, 2011).

The agricultural sector in Ghana has the potential to grow at rates as high as six percent per annum (Breisinger, Diao & Thurlow, 2008), but climate variation inhibits such progress. Vulnerability of Ghana's agriculture to climate variations is largely due to its dependence on rainfall (Yaro, 2010). Ghana is already experiencing a monthly rainfall decrease of about 2.4 percent per decade, and an increase in the mean annual temperature of 1°C per decade since 1960 (Government of Ghana, 2011; McSweeney, New, Lizcano & Lu, 2010). Future climate scenarios predicted by global circulation models (Nakuja, Sarpong, Kuwornu & Felix, 2012) and cited by Alessandro et al. (2012) generally agree that temperatures will rise. Based on a review of 15 different



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models, Ghana's mean annual temperature is expected to increase between 1.0°C - 3.0°C by 2060 and 1.5°C - 5.2°C by 2090 with the increase expected to be more pronounced and severe in the north of the country.

According to Challinor, Wheeler, Garforth, Craufurd and Kassam (2007), climate variation occurs mainly as the result in the changes in the rainfall and temperature regimes in Ghana. This to him is causing a lot of post-harvest losses due to the outbreak of pests and diseases that thrive in such climate conditions.

Productive lands are getting lost as a result of prolonged droughts caused by erratic, and short duration of heavy downpours. The likely consequences of water and heat stresses include yield reduction, decreased livestock values, increased post-harvest losses, and food insecurity (Vermeulen, Aggarwal, Ainslie, Angelone, Campbell, Challinor,..&Lau, 2010).

The negative effects of climate variation on Ghana's agriculture were highlighted by a recent study conducted at the International Food Policy Research Institute (IFPRI, 2012) who said that climate variations will have adverse effects on yields of rain-fed maize, rice, and groundnuts by 2050. According to the predictions, there will be a small reduction in rainfed maize of about 25% in all the ecological regions of Ghana. The fall in cereal crop yields will mainly be due to the reduction in the growing period, and to an increase in evaporation rates. A moderate yield decrease of rainfed-groundnuts is expected. The Micro-Industry Credit Rural Organisation's model (MIROC) by IFPRI (2012), shows many areas with a yield decrease of up to 25%. According to Sagoe (2006), production of cassava will reduce by 53% by 2080, and cocoyam by 68% by 2050.



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**Effects of Climate Variation on Farmers in Ghana**

The impacts of climate variation on agriculture are expected to greatly affect those who depend on the sector for their livelihood. As indicated earlier, in Ghana, about 95% of crop farming is done under rainfed conditions. This implies that changes in rainfall pattern, especially in the duration, and the amount, will affect crop yields; and this will have negative implications on the livelihood of farmers.

The Ghana Agricultural Workers Union (GAWU) of the Ghana Trades Union Congress and Friedrich Ebert-Stiftung (2012) highlighted the negative effects of climate variation on Ghanaian farmers. According to GAWU, crops are getting destroyed due to periods of heavy rains. A publication posted on the website of the newspaper "The Chronicle" (October, 2011) indicated that unpredictable rainfall and shifting weather patterns have made the planning of the planting season increasingly difficult for farmers. The Newspaper on its website further reported that, depletion of ground water reserves due to prolonged droughts and loss in soil fertility from floods have caused drops in food crop yields; and this has put food security and income generated from food crops by farmers in jeopardy. GAWU and Friedrich Ebert-Stiftung (2012) have observed that some 91 percent of farmers' income has decreased due the negative effects of climate variation on their crops and livestock.

All over the country, soils have increasingly become poor as a result of climate variation. Soil micro-organisms that lived in and improved the quality of soils through their biogenic activities, have left their habitations due to heat that have killed the plants they feed on.



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This has led to poor crop yields and has also entrenched farmers in poverty and in food insecurity (Ghana Centric, 2010).

**Gender and Agriculture in Ghana**

The Population and Housing Census of Ghana Statistical Service (2010) indicates that women constitute 51.2 percent of the total Ghanaian population of 24.7 million. These are mostly rural dwellers engaged in agricultural production. Rural women in Ghana produce about 70% of food crops. They are also key stakeholders in agro-forestry and fisheries, and the major actors in food processing and food distribution industries (Ministry of Food and Agriculture, 2010; MOWAC, 2012).

While agriculture continues to be the backbone of Ghana's economy, it is largely gendered. The gender dimensions of agriculture in the country are found in land acquisition and ownership, labour, access to and use of improved agricultural technologies and access to credit (Boateng, Adomako-Ampofo, Flanagan & Yakah, 2006; MOWAC, 2012). With regard to land acquisition and ownership, there are significant gender disparities in land holdings in Ghana. Men hold 3.2 times more of the total number of farms than women, and about eight (8) times more of the medium-large farms (of 5 acres and more) (FAO, 2012). Men often have full rights to land, while women have partial or conditional (secondary) rights (FAO, 2011b). Men have increased access to modern agricultural innovations and technologies than women because of the high poverty levels among women. The FAO (2011b), indicates that a clear division of labour according to sex and age exists in the Ghanaian farming communities. For example, women are more involved in farming activities such as planting, weeding, harvesting, transportation of farm produce, agro-



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processing and marketing of farm produce, while men are more involved in the initial clearing of the land and the marketing of larger amounts of farm produce, especially at the farm gate. Furthermore, women are more involved in food crop production, and men in cash crop (Duncan & Brants, 2004).

**Importance of Cassava in Ghana**

Cassava is an important staple crop to smallholder farmers in Ghana. It is the second most consumed food crop in Ghana after maize. Although cassava has been grown primarily as a staple crop, it has now become a commercial crop as markets expand in urban areas of Africa and around the globe (Curran, Anderson, Gugerty & Cook, 2009).

Cassava cultivation represents approximately 50% of all root and tuber crops production in Ghana, and it is grown by 90% of the farming population (Sagoe, 2006). A greater proportion of the cassava grown in the country is by small-scale farmers with small landholdings (Kleih, Phillips, Wordey, Komlaga & Posthumus, & Gregory, 2013). As a subsistence crop, cassava is often considered women's crop with the explanation that women are responsible for feeding the family and thus prefer to grow crops for the household. It is grown in almost all the ecological regions of Ghana, but it is particularly abundant in the Central, Eastern, Brong Ahafo, Volta, and Ashanti regions (Kleih et al., 2013). In terms of quantity produced in Ghana, cassava is the most important root and tuber crop. It is followed by yam and cocoyam; but it ranks second to maize in terms of area planted (MoFA, 2011). The production of cassava in Ghana ranged from 10,217,929 metric tonnes to 12,260,330 metric tonnes between 2007 and 2009 (MoFA. 2011). While these figures may give the impression of a consistent increase in production of the crop, the net produce



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left after consumption (4 million metric tonnes) falls short of the quantity needed to feed the country's only operating cassava-starch factory, the Ayensu Starch Company located at Bawjiase (MoFA, 2011).

An important aspect of cassava is that it generates extensive farm and non-farm linkages along the cassava value chain, since it is utilised in various forms. Apart from cooking the fresh root, it can be processed into gari, tapioca (toasted starch), and cassava flour (crude and refined). All these products are used for human consumption. Some people consume the cassava leaves. Dried cassava chips and cassava pellets are increasingly becoming common livestock feed in Ghana. Cassava derivatives form the base of several products such as foods, confectionery, glues, plywood, textiles, paper, monosodium glutamate, beer and drugs (International Institute of Tropical Agriculture (IITA, 2014).

**Climate Variation and Cassava Production in Ghana**

Climate has been identified as the principal factor that controls crop distribution and growth in Ghana (Sagoe, 2006). While some crops have stable genotypes and therefore do not react to variation in environmental changes, others are excessively stressed by slight changes in the climate. The main factors affecting cassava and the other root and the tuber crops production are drought, water logging, temperature extremes, and solar radiation extremes (Sagoe, 2006). In Ghana cassava production suffered a decline during the drought period of 1990. Analysis on the state and trends of root crop production in the country indicate a positive correlation between yields and total rainfall with a correlation factor R of 89 – 92% and mean daily temperature of R <50% (Sagoe, 2006). Climate characteristics affecting cassava production are:



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- Unreliable, irregular and unpredictable rainfall. Duration of rain is getting shorter and it is either too much (flooding) or too little (drought).
- High daily temperature scorching crops.
- Prolonged drought, has increased the population of variegated grasshoppers that destroy cassava.

Sagoe, (2006) has said that, yields of cassava are expected to reduce with increasing temperatures and solar radiation, and reducing amounts of rainfall.

**Effects of Climate Variation on Gender Farming in Ghana**

As stated earlier in this chapter, the Ghanaian agricultural system is gendered, with men and women having different roles in terms of labour at the farm level. Disparities in landholdings and access to improved technologies and credit are identifiable among male and female farmers in Ghana (Boateng et al, 2006, Doss & Morris, 2000. Duncan et al., (2004), have stated that majority of women in the agricultural sector in Ghana rely on food crop production for their livelihood hence, it is they who will suffer the most from any negative effects from climate variation.

Rose (2007) has observed that, land is becoming scarce in certain communities in Ghana due to seasonal flooding. The majority of women in such communities are consequently engaged in mixed-crop farming on small plots, but because socio-cultural and land tenure practices deny them sufficient access to fertile lands, their plots are the ones which tend to be affected primarily by climate variation. Yet they don’t have access to extension services and to credit facilities.



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**Vulnerability to the Effects of Climate Variation**

The IPCC (2007b) defines, vulnerability in the context of climate variation as “the degree to which a system is susceptible to and is unable to cope with the adverse effects of climate variation, and extremes.” According to the IPCC (2007b), vulnerability is defined by exposure, sensitivity, and adaptive capacity. In this case climate vulnerability is a function of the character, magnitude, and rate of climate variations to which a system is exposed, of its sensitivity, and its adaptive capacity. Exposure represents the background stimuli against the climate conditions or any changes in those conditions which a system operates. Hence exposure as a component of vulnerability is not only the extent to which a system is subjected but also to the degree and duration of the variations (Adger, 2006).

Sensitivity reflects the responsiveness of a system to changes in its surrounding, and the degree to which changes in climate might affect it in its current form. Sensitivity of a system to the effects of climate variation from the perspective of the present study means the degree to which people are affected, either adversely or beneficially, by the variation (IPCC, 2007b).

Adaptive capacity in the context of climate variation has been defined by the IPCC (2007b) as “the ability of a food producing system to adjust to climate variation and extremes, to moderate potential damages to take advantage of opportunities and to cope with the consequences.” Adaptive capacity therefore comprises the adjustments in behaviour and in resources that include technologies (Adger, 2006).



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***The Conceptual Origins of Vulnerability***

Before gender dimensions in vulnerability to adverse climate effects, is stated, it is important to trace the conceptual origin of vulnerability. Concentrating on disaster (including those emanating from climate variation) studies, two major schools of thought on vulnerability have been reviewed which are of relevance to the present study. These are the livelihoods perspective and political ecology point of view.

***Livelihood Perspectives***

The livelihood perspective provides an actor-relation notion of vulnerability and builds on entitlements theory (Sen, 1981; Sen,1984; Department for International Development (DfID 1999) with a rural bias (Chambers, 1983). Departing from conceptions of rural lives that focus on agriculture as the principal source of income, this perspective recognises a variety of means through which an individual (or more often a household) can earn a living. Here, vulnerability is connected conceptually to external stresses and shocks and internal coping capacity (Chambers & Conway, 1992). In this perspective, a livelihood is understood as a composite of a household's capitals, activities and access to resources, framed in an institutional context. The five capitals often cited in the livelihoods literature are physical, human, financial, social and natural (Ellis, 2000).

Activities can be unpaid, like sharecropping and subsistence farming, or paid, such as factory work and farm labour. In theory, a household facing a shock should have the ability to change or modify livelihood or exchange its capitals. The flexibility of this interchange, however, must be recognised as being moderated by value considerations and contestations (Arce, 2003; de



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Haan & Zoomers, 2005; Matyas & Pelling, 2012), property relations and configurations of power in the institutional context (de Haan and Zoomers, 2005).

Ultimately, the strengths of the livelihoods approach are its ability to recognize and articulate the agency of individuals and households to manage resources when facing shocks and to express how these dynamics play out at the local level. For instance, this perspective opens questions regarding trade-offs between various capitals, the prospect of exhausting assets, and the possibility of a household spiralling into collapse (Swift, 1989). From a reduction of savings to a loss of productive capital, the livelihoods approach can help to express the 'ratchet effect,' wherein each new hazard event (or the progression of a slow-onset event) increases the vulnerability of those affected to future events (Chambers, 1983).

The limitations of the livelihoods approach are that it tends to neglect political and structural forces (de Haan & Zoomers 2005), overlook the interaction of household agency with these forces, and not account for physical and ecological dimensions of risk. Generally, these limitations continue to influence modern understandings of vulnerability

***Political Ecology***

Political ecology places explanatory emphasis on both the structural relations that underpin vulnerability, and the environmental systems generative of hazard and opportunity. It presents an attempt to bring both perspectives together in analysis and accept that neither operates independently. It is also a response to both the physicalist bias of the hazards management approach and the structural orientation of the political economy school (Hewitt, 1983) that



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emerged as its critique in the 1980s (Pelling, 2001). In an effort to incorporate issues of power and politics into a domain dominated by technical explanations, this perspective seeks to explain why certain groups live in more exposed areas, experience different impacts from shocks, have disparate capacities to cope with/adapt to hazardous events and are impacted differently by external disaster response and risk reduction efforts (Gaillard, 2010).

Political ecology's broad scope and interdisciplinary nature lends itself to multiple definitions and understandings. However, common assumptions across the field give it relevance. Bryant, Raymond and Bailey (1997) have developed three fundamental assumptions in practicing political ecology:

- First, costs and benefits associated with environmental change are distributed unequally. Changes in the environment do not affect society in a homogenous way: political, social, and economic differences account for uneven distribution of costs and benefits.
- Second, this unequal distribution inevitably reinforces or reduces existing social and economic inequalities. In this assumption, political ecology runs into inherent political economies as "any change in environmental conditions must affect the political and economic status quo." (Bryant & Bailey, 1997).
- Third, the unequal distribution of costs and benefits and the reinforcing or reducing of pre-existing inequalities holds political implications in terms of the altered power relationships that now result.

One critique of the political ecology approach is that its descriptions of inequalities are somewhat generic. With difficulty distinguishing between different susceptibilities to harm, disparities in resource distribution and



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opportunity are expressed with relatively low resolution (Eakin & Luers 2006).

Another important critique of political ecology relates to the issue of agency. Early versions of this perspective had a propensity to concentrate on structural dimensions of vulnerability (Cuny, 1983). This focus downplayed actors' capacities to cope with and adapt to shocks and thus tended to infer vulnerable people as passive or incapable victims (Wisner. Blaikie, Cannon & Davis, 2004: Bankoff , 2003).

Political ecology attempts to provide critiques as well as alternatives in the interplay of the environment and political, economic and social factors. Robbins (2004) asserts that the discipline has a "normative understanding that there are very likely better, less coercive, less exploitative, and more sustainable ways of doing things" (Robbins, 2004).

From these assumptions, political ecology can be used to:

- Inform policymakers and organizations of the complexities surrounding environment and development, thereby contributing to better environmental governance.
- Understand the decisions that communities make about the natural environment in the context of their political environment, economic pressure, and societal regulations
- Look at how unequal relations in and among societies affect the natural environment, especially in context of government policy

**Gender Dimensions in the Vulnerability to Effects of Climate Variation**

According to IPCC (2007b) and Adger (2006), vulnerability of a population to climate variation depends on three factors: first, the degree of



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exposure to climate variation phenomena; second, the population's sensitivity to the phenomena; and third, the population's capacities to adapt to the changes as espoused by the political ecology theory. The last two factors are determined by economic and social conditions, as well as the degree of political and geographic marginalisation of the population. Generally, poverty and marginalisation are associated with high level of vulnerability to climate change or variation impacts, although conflicts and wars are often the cause. The effects reduce capacities for adaptation due to the limited access to economic and other resources, and to information networks.

Ahmed, Diffenbaugh Hertel, Lobell, Ramankutty, N., Rios and Rowhani (2008) has observed that climate variation will affect people across the world; however, certain groups especially women will be more vulnerable to climate shocks. In order words, women will likely experience severe consequences than men. In the same way, poor communities are expected to be more acutely affected partly due to their limited access to information and financial resources as indicated by the livelihood perspective theory. Gender-based differences in rights, time use, and access to assets, resources and credit, and to socio-cultural norms also increase one gender's vulnerability to the effects of climate variation (Habtezion, 2012). For example, being the bread winners of families, females are generally left with the task of finding solutions to the complications arising from the socioeconomic and food situation that follow natural disasters or crop failures (Babugura, (2010); Jungehülsing, 2010). Thus, assessing the vulnerability of males and females to climate variation effects implies examining their respective exposure to the effects of



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climate variation. It also implies examining the differing sensitivities to the direct effects of climate variation and to their adaptive capacities.

Vulnerability to climate variation of males and females depend on the comparative disadvantage of each gender ability to cope with, recover from, or adapt to the variation in climate. Females' direct dependence on natural resources increases their vulnerability to climate stresses. For example, most women living in rural African communities are responsible for agricultural production and collection of water for drinking (UNDP, 2009). It is most probable that females will be more affected than males by the changes in the climatic conditions which may affect traditional growing and harvesting cycles (Neumayer & Plümper, 2007).

**Gender and Vulnerability to Climate Variation in Ghana**

Ghana is among the most vulnerable countries to the effects of climate change or variation because of the dependence of much of her population on agriculture, particularly on rain-fed agriculture, and because of widespread poverty among the population which renders them unable to withstand climate stress (Stanturf, Warren, Charnley, Polasky, Goodrick, Armah & Nyako, 2011). Majority of the population in Ghana dwell in rural areas where agriculture is the main source of livelihood. The high dependence on favourable climatic conditions for crop production tends to make the people who depend on agriculture related activities in the country more vulnerable to the negative effects of climate variation (Nelson & Agbey, 2005).

There is clear evidence that in the coastal zones, agriculture (fisheries, cocoa, cereals, and root crops production), and water resource sectors as well as human health and rural livelihoods are affected by climate variation (The United



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Nations Development Programme (UNDP), 2013). The patterns of vulnerability to the impacts of variations in climatic elements in Ghana are largely shaped by social factors ranging from gender roles to class and ethnicity. Gender roles are further shaped by access to livelihood resources, roles in markets (who sells what, and to whom?), and political structures (who arbitrates disputes?) (Stanturf, et al., 2011). For example, increased access to and control of resources improves diversification options during the time of climate change or variation. Stanturf et al, (2011) have observed in Dominase and Ponkrum in the Central Region of Ghana that several men in the rural communities actually rent out inherited lands for financial gains. This enables them to invest into other economically viable ventures other than agriculture, thereby reducing their vulnerability to climate variation.

Other determinants of vulnerability are poverty, and natural resource dependence (Adger, 1999). Poverty reduces one's adaptive capacity, and increases vulnerability. In Ghana, the poor tend to depend heavily on environmental goods and services. Their livelihoods are mostly derived from dependence on crop farming, fisheries and forestry, the occupations which are vulnerable to the adverse effects of climate variation (Winfred & Agbey, 2005). According to Wrigley-Asante (2008), females in Ghana are generally poorer than their male counterparts because they are not highly educated. This reduces their ability to access and process climate smart agriculture information.

## Adaptation to Climate Variation

### *Theories underpinning adaptation to climate variation*

Two theories that underpin adaption to climate variation and provide theoretical basis for the present study are the cultural and action theories.



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***The cultural theory of climate variation risk***

The way in which people perceive climate variation risk is informed by their social interactions and cultural worldviews comprising fundamental beliefs about society and nature. Therefore, perceptions of climate variation risk and vulnerability along with people's "myths of nature" (that is, how groups of people conceptualize the way nature functions) influence the feasibility and acceptability of climate adaptation planning, policy making, and implementation.

The role that culture plays in contemporary climate variation adaptation is not a well understood or studied area ( Adger & Coauthors, 2009). Yet, culture, the full range of learned ideas and behavior patterns that are acquired, shared, and modified by people as members of a society, is lending meaning to perceptions of climate risk, and guiding decisions about whether to address climate variation, and if deciding to take action, what it will be.

While there are multiple theories about how culture informs people's perceptions of risk, decisions, and behavior, the culture theory of climate variation risk (CTR) helps to explain how social organizations and institutional cultures frame risks differently and how those different framings create respective "voices" about climate variation risks and responses in various public forums. The evolution of CTR has shown that people change their adaptation preferences to risks based on different contexts and experiences over time (Spickard, 1989; Rayner, 1992; Bellamy & Hulme, 2011). This is consistent with an understanding of culture that is dynamic and emergent (Wolf, 1982). As such, this is a fundamentally different understanding of culture and risk



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perceptions from the essentialist framing where cultural risk perceptions are inherent in individual personality traits or cognition.

Also, important for the CTR are "myths of nature," which underpin perceptions about environmental and climate risks (Schwarz & Thompson 1990). Myths of nature describe how the relationship between society and the environment is configured and different ways that nature functions, including how the climate system works (O'Riordan & Jordan 1999; Hulme 2009). Following Thompson, Ellis, & Wildavsky (1990), the term myths of nature to refer to the narratives, beliefs, and social constructions that determine cultural interpretations about how nature and ecosystems function. Climate solutions will be more effective when they reflect the multiple voices and views on nature held by groups of people who will need to sanction or will be affected by the measures.

According to CTR, how risks are framed corresponds to different types of worldviews. Worldviews are the constellation of values and beliefs about how society should be organized. CTR holds the view that there are four competing worldviews (egalitarian, hierarchist, individualist, and fatalist), which function as culturally informed classification systems so that "people select awareness of certain dangers to conform to a specific way of life" (Douglas & Wildavsky 1983). Douglas' work was informed by an earlier classificatory British anthropology where individuals and societies were thought of as having relatively immutable associations and preferences. CTR argues that certain forms of social organization are associated with each of the types of worldviews. Different forms of social organization therefore view and manage risks differently (Rayner, 1992). This can lead to conflict between



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groups with different institutional cultures about how they recognize risks and approach solutions (Thompson & Rayner, 1998). CTR thus explains conflict as arising from mismatched worldviews about how risk is identified and managed.

As such, it is the social organization of institutions, rather than the threat itself, that determines what risks are recognized, the process for obtaining social consent about each risk, and how liabilities and benefits arise (Wildavsky, 1982; Rayner, 1984; Gross & Rayner, 1985). This understanding contrasts with conventional views of risk analysis, communication, and management that frame risk as quantitative probabilities of certain extreme events. Such risk framing ignores that risk communication and management are predicated on shared meaning and trust among individuals who make up the communities and institutions where mourns values and policies are established or made and implemented (or not) (Rayner, 1992).

### *Action theory of Adaptation*

In the IPCC definitions and the analysis of Smit et al. (2000), adaptation is a response to (potential) environmental stimuli that affect given entities, subjects or systems. Adaptations are processes within entities and systems, or adjustments made by human systems. The Action theory approach specifically refer only to human individuals and collective actors. According to the action theory, actions requires actors and an intention. The intention is directed towards an impact of climate variation. Furthermore, adaptations require the use of resources as means to achieve the intended ends

For the core concepts of the action theory of adaptation it is not sufficient to consider social processes alone, as might be appropriate for a purely sociological issue. For investigating adaptation to climate variation, there



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is the need to discuss the relation of actions beyond social processes and actions, since the interlinkages to the natural environment are crucial. The Action theory approach remains compatible with conceptions of contextual vulnerability (O'Brien, Eriksen, Nygaard & Schjolden, 2007), since it is possible to focus on the means and conditions for operators independently from the actual occurrence of stimuli. The definition of action as being the subset of social processes ('acts') that are associated with intention is established in analytical philosophy (for example, Wilson, 2008). When complex real-world adaptations are to be analyzed with the theory, the following concepts need to be recombined in different ways to consider multiple interrelated actors. These are; stimulus, exposure unit, impact, operator, purpose, receptor, means (available means, employed means and necessary means) and Conditions.

In the theory, a stimulus is defined as a change in biophysical (in particular meteorological) variables associated with climate change. Stimuli can refer to changed values of statistical parameters such as average intensity, frequency, or higher statistical momenta (for example variance). Exposure unit broadly refers to all those actors, social, technical or non-human systems that depend on climatic conditions, and are therefore exposed to stimuli. By an impact of climate variation it means a combination of a stimulus and an exposure unit. More broadly, it can be a set of stimuli with an associated set of exposure units. For example, reduced energy production of a thermal power plant (exposure unit) due to more frequent scarcity of cooling water (stimulus) is an impact. In the theory, the individual or collective actor that exercises the response is called the operator, for example, a private household, a firm or a government. Not all activities of an operator are actions. Only those activities



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with a purpose qualify for this term. The operator tries to achieve intended ends that are associated with (other) actors, social or non-human systems. The actor or system that is the target of an adaptation (the purpose) is called the receptor. Receptors can be both biophysical entities and social systems, depending on the objective of analysis. It is further not required that the receptor of an adaptation is an exposure unit at the same time.

According to the action theory to implement the adaptation, the operator needs resources, here called means. These could be access to financial or other material resources, legal power, social networks, knowledge, or availability of information. It is helpful to further differentiate three notions of means: available means, employed means and necessary means. Available means are those that are disposable by the operator, while the employed means is that part that is actually used for a specific adaptation. Effective, adaptation requires the use of the necessary means, which might be available or not. It is important to note that these three types of means are not necessarily identical. Action is further shaped by constraints and resources that cannot be controlled by the operator. These are called the conditions (Parsons, 1937).

**Concept of Adaptation to the Adverse Effects of Climate Variation**

It is important that the specific vulnerabilities of individuals are taken into account when adaptation measures are being developed. In order for adaptation to be effective, measures carried out must focus on reducing the vulnerabilities of individuals or groups. Such measures include eradicating their economic, social, geographic and political marginalization (IPCC, 2007b).

Adaptation is a key to the enhancement of a resilience to a vulnerable system (Stakhiv, 1993; Bohle, Downing and Watts, 1994; Burton, Kates &



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White, 1993; Smit et al., 2000; IPCC, 2001). According to Walker, Gunderson, Kinzig, Folke, Carpenter and Schultz (2006), resilience refers to the ability of a group or system to withstand shocks in order to maintain its structure and identity. Chambers and Conway (1992), have observed that resilience in social context depends on people's capabilities to adapt to internal and external shocks and stresses. This means that when a change such as climate variation occurs, resilience provides mechanisms for restoration and reorganisation that are critical for adaptation (Gunderson & Holling, 2002, Berkes et al., 2002). Resilience is basically the opposite of vulnerability. Less resilient systems become increasingly vulnerable to disturbances that were previously within the coping limits of a system (Quinlan, 2003).

Adaptation is not new to farming communities in Sub-Sahara Africa (Antwi-Agyei, 2012). Whereas the international community has recognised the role that adaptation plays in time of climate variation, the origins of adaptation have been traced to the natural sciences, in particular to biology and evolutionary ecology (Winterhalder, 1980) as cited by Antwi-Agyei (2012). The specific definition given to adaptation depends primarily on the subject area. For instance, in ecology, adaptation refers to the ability of an organism to adapt to changes in its environment (Martin, Ruse & Homes, 1996). Even though the impacts of climate variation on agriculture is one of the most widely studied areas, until recently, such studies neglected the role of adaptation by farmers (Schipper & Burton, 2009). Prior to 1992, the term adaptation was rarely used in relation to climate change or variation (Schipper & Burton, 2009). The focus of international community was on mitigation, which involved reducing the emissions of greenhouse gases and increasing carbon sinks,



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thereby slowing the rate of global warming (IPCC, 2007a). For instance, Stringer, Dyer, Reed, Dougill, Twyman and Mkwambisi, (2009) reported that, advocates of adaptation were viewed as not addressing the issue of global warming; they were thought as demonstrating lack of confidence in their abilities to limit carbon emissions (p. 750). Even then, the world will likely continue to warm at a significant rate for many decades (IPCC, 2007a).

Central to the understanding of climate adaptation in agricultural systems and livelihoods are adaptive and coping capacities. Coping and adaptive capacities are mostly distinguished with reference to timescale. Adaptive capacity is linked to long-term strategies whilst coping capacity include short-term strategies (Smithers & Smit, 1997). In the present study, coping capacity refers to short-term strategies taken by farming households and communities to contain the immediate negative impacts of climate variation (Campbell et al., 2011).

**Types of Adaptations**

According to the IPCC (2007b) report, various types of adaptation can be identified. These include anticipatory, autonomous, and planned adaptations. The report defines anticipatory adaptation as the adaptation that takes place before impacts of climate change or variation are observed, while autonomous adaptation is defined as the adaptation that does not constitute conscious response to climatic stimuli, but is triggered off by ecological changes in natural systems, and by market or welfare changes in human systems. Autonomous adaptations are coping strategies which are temporary and reactive in nature and are implemented by individuals, agents and institutions (Dinar, Hassan, Mendelsohn & Benhin, 2012). For example, in response to a changing



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precipitation pattern, a farmer may decide to change the crops, or use different harvest and planting dates (FAO, 2007). Hence, the effectiveness of autonomous adaptation strategies depends on the availability and accessibility of resources to cope with sudden climate events (Mendelsohn et al., 2008).

Planned adaptation on the other hand, refers to adaptation that results from a deliberate policy decision based on the awareness that conditions have changed, or are about to change, and that action is required to return to maintain, or achieve a desired state (IPCC, 2007b). Indeed, planned adaptation seeks to address future climate stresses, and is based on predicted future climate adverse impacts, and on past experiences (Fankhauser, Simth & Tol, 1999). The present study explores the gender concerns involved in both autonomous and planned adaptation strategies employed by cassava farmers in the Awutu Senya District to reduce the adverse impacts of climate variation on their livelihoods. Planting drought-tolerant and early maturing varieties of crops, for example, are some of the planned adaptations, while resorting to the reduction in food consumption by households, because of climate related food insecurity is autonomous adaptation strategy. Since gender disparities in vulnerability to the adverse effects of climate variation implies that males and females have different priorities, it is presumed that responses to climate variation in terms of coping and adaptation will differ along gender lines.

Farmers' vulnerability to the impacts of climate variation is associated with the adverse effects of climate variation on agriculture. It has been established by Lobell, Banziger, Magorokosho and Vilvek (2011) and Nelson, Rosegrant, Palazzo, Gray, Ingersoll, Robertson,..& Msangi, (2010), that climate variation influences crop distribution and production, and it increases risks



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associated with farming. As climate variation impacts negatively affect agriculture, farmers will have to identify ways of reducing their vulnerability to climatic threat.

**Empirical Studies on Gender and Climate Variation Adaptations and the Conceptual Framework of the Study**

This section presents reviews of relevant studies on the approaches adopted in assessing gender relations in climate variations and adaptation. It also presents empirical evidence on gender mainstreaming in climate variation adaptation programmes of some countries using various established gender and climate variation and adaptation analysis models. The chapter further reviews models and analytical frameworks that have been employed to assess adaptations to the effects of climate variation elsewhere from a gender perspective in the quest of finding the one model that best suits the objective of the present study.

**Empirical Review of Gender Related Approaches of Analysing Vulnerability and Adaptation Climate Variation**

There are several approaches and toolkits that have been produced as guides to gender and development. With the recognition of the importance of gender in relation to climate variation and adaptation, there are also an increasing number discussing methodologies related to climate variations and gender developed by various leading multilateral institutions, which provide guidance on participatory methods to integrate gender into climate variation programnmes. These focus on, among other things, gender equity and equality,



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women's empowerment, gender mainstreaming and gender transformative approaches.

Each toolkit identifies methodologies for integrating gender into projects and interventions; however, they do not necessarily recommend the same techniques or initiatives and approach gender integration through different lenses. The following are discussions of some of the approaches and their practical applications

**Gender Analysis Approaches to Climate Variation and Adaptation in Mozambique**

A study in Mozambique on gender and climate variation (Ribeiro & Chaúque, 2010) adopted the Gender Analysis Matrix (GAM) approach to help determine different impacts of climate variation on women and men, by providing a community-based technique for identifying and analysing gender differences. Gender Analysis Matrix (GAM) is a technique that is generally used determining the different impacts of a project or issues on women and men, by providing a community-based technique for identifying and analyzing gender differences. It separates out the different impacts and other vulnerable groups so researchers may accommodate the different needs and interests of these groups.

The study covered two communities; Mapai-Nga and Magondzwene (Table 1). In both communities subsistence agriculture is the main activity with both male and females actively involved. The gender analysis revealed that men's roles in agriculture are to helps women in plough and harvest in low years of production while in good year of production they participate in all activities. The analysis also revealed that women are in charge of agriculture but being



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helped by children and men. With regards to access and control over resources, both men and women have access to land for cultivation. However, men are the ones who have the control over land (They decide where to cultivate and what to do with the proceeds). Only in case of women-headed households and in cases where there are no family men in the community, can women control land. For fishing as an occupation, the GAM results indicate that men were in charge of this activity, women only work as helpers through cleaning and selection of fish for commercial purposes. They get paid either by product or money. Hence women have limited access and control over this activity and the profits from it.

The researchers also used a climate variation impact assessment to help identify the possible impacts of climate variation on women and men in the community. The analysis tools used revealed that, the envisaged impacts of climate variation will be gender differentiated due to unbalanced labor division and the decision-making structure of these communities. According to the results at the family level, one of the main causes of the differentiated impact of changing environmental conditions is the power relations, which gives women access to but not control over natural resources. For instance, the customary law in both communities is that land, cattle and other assets can only be inherited by men because women may leave the community when they get married. This creates a dependency of women on men's decision about where to establish houses and what livelihood strategies they should adopt even though women (because they never leave the area and depend more on natural resources) usually know the area better. Another important cause of the differentiated impacts of environmental variation is the established rule that women are



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responsible for reproductive work but at the same time their role on productive work is increasing. This imposes higher pressure on women as they have to guarantee family stability at all levels (health, nutrition, and economics).

Ribeiro and Chaúque (2010) applied an analysis of influencing factors to decide what determines the differences identified in the gender division of labour and with regards to access to and control over resources. They discovered that customary laws play very significant roles on decision making in both communities. Additionally the traditional or societal setting determines men's and women's social roles. They further applied an institutional analysis to look at how institutions behave and function according to informal rules-in-use, norms and formal rules and laws. The existing policy or institutional system in the country still doesn't provide a strong basis for gender equality and equity.

However, the situation is changing and the legal framework is being adjusted to guarantee the mainstreaming of gender issues in climate variation adaptation strategies. For example the strategic plan for Gaza Province has as one of its priorities "to promote gender equity and increase women's participation in the socio-economic development of Gaza Province". To achieve this some of the planned measures are: (i) to empower women in aspects of leadership; (ii) to promote women's participation on politics and decision-making structures; (iii) improve women access to the work-market; (iv) to implement programs for the diversification of subsistence crops and access to improved technologies including agro-processing; (v) improve the access to health care services and nutrition programs.

They carried out access and control and social profiles to answer the question 'Who has access to and control of knowledge, resources, services and



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decision making and what kind of relationships exist that create and reproduce differences between women and men?' According to their results although women are crucial and active members of these communities they don't have much of an active voice since most community structures are male-dominated. At the family level, women submit to their husbands. If he is not present, they submit to either the oldest son or the closest family man to make decisions. At the community level, the decision-making structure is still also male-dominated.

The researches also used capacity and vulnerability analysis to identify what will help (capacity) and what will hinder (vulnerability) the adaptation to climate variation. Finally, a needs assessment provided a method of assessing the practical needs and the interests of women and men that must be addressed.

The results of this study has exposed the underlining gender issues and gap that hinder development and effective adaptation to climate variation by community members. This offers an opportunity to devise gender sensitive and specific strategies in addressing these gaps.



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**Table 1: Activity Profile for Magondzwene and Mapai-Nagale communities of Gaza Province in Mozambique**

| Community | Activity | Men's role | Women's role | Access and control |
|---|---|---|---|---|
| Magond-zwene | Subsistence Agriculture: the most important activity in this community Uses rudimentary techniques such as slash and burns small axe and plough | In low years of production men helps women in plough and harvest. In good year of production they participate in all activities. | Women are in charge of agriculture being helped by children and men | Both men and women have access to land for cultivation. However, men are the ones who have the control over land (They decide where to cultivate and what to do with the exceeding production). Only in case of women-headed households and in case that there are no family men in the community, can women control land. |
| | Fishing: it has gained relevance in the last few years, due to drought. It is both commercial and subsistence. They use small boats and fishing nets | Men are in charge of this activity | Women work as helpers through cleaning and a selection of fish for commercial purposes. They get paid either by product or money. | Women have limited access and control over this activity and the profits from it. |
| | Livestock production: Nowadays this is the third most important activity, but used to be as important as agriculture. due to the prolonged drought most people lost their animals | Men are exclusively in charge of this activity. they basically take the herds to the grasslands and to the drinking points in the morning and in the afternoon they have to bring the herds back home. | No role in this activity | Both access and control over this activity is done by men due to the fact that cattle are an expression of wealth, men are the ones in charge of everything and the inheritance process is from father to sons only. |



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**Table 1 Continued**

| | | | | |
|---|---|---|---|---|
| | Subsistence Agriculture: the most important activity in this community Uses rudimentary techniques such as slash and burns, small axe and plough. During the wet season is conducted in higher places, but during the dry season people cultivate along the Limpopo River | In low years of production men help women in plough and harvest. In good years of production they participate in all activities. | Women are in charge of agriculture being helped by children and men. | Both men and women have access to land for cultivation. However, men are the ones who have the control over land (They decide where to cultivate and what to do with the surplus production). Only in case of women-headed households and in case that there are no family men in the community, can women control land. |
| | Livestock production: nowadays this is the third most important activity, but used to be as important as crop cultivation. Due to the prolonged drought most people lost their animals. | Men are exclusively in charge of this activity. They basically take the herds to the grasslands and to the drinking points in the morning and in the afternoon they have to bring the herds back home. | No role in this activity | Both access and control over this activity is done by men. Due to the fact that cattle are an expression of wealth, men are the ones in charge of everything and the heritage process is from father to sons only. |
| | Trading: this activity has gained importance in the last few years as a result of decrease in crop production and the need to get money to buy day-to-day products. It is done both within and outside the community. Trading includes also | Men are in charge of this activity, especially in selling fish outside the community.<br>They are also the main consumers of alcoholic drinks from women. | Women are in charge of selling fruits and vegetables in small amounts. They also produce and sell alcoholic drinks, but the money they earn is controlled by men. | Both men and women have access to this activity, but men are the one that control it. All the profits from the trading activity are controlled by men. |



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**Table 1 continued**

| | | | | |
|---|---|---|---|---|
| | alcoholic drinks that have gained popularity lately. | | | |
| MAPAI-Ngale | Subsistence Agriculture: the most important activity in this community. Uses rudimentary techniques such as slash and burns, small axe and plough. during the wet season is conducted in higher places, but during the dry season people cultivate along the Limpopo River | In low years of production men help women in plough and harvest. In good years of production they participate in all activities. | Women are in charge of agriculture being helped by children and men. | Both men and women have access to land for cultivation. However, men are the ones who have the control over land (they decide where to cultivate and what to do with the surplus production). Only in case of women-headed households and in case that there are no family men in the community, can women control land. |
| | Livestock production: Nowadays this is the third most important activity, but used to be as important as agriculture. Due to the prolonged drought most people lost their animals. | Men are exclusively in charge of this activity. They basically take the herds to the grasslands and to the drinking points in the morning and in the afternoon they have to bring the herds back home. | No role in this activity | Both access and control over this activity is done by men due to the fact that cattle are an expression of wealth, men are the ones in charge of everything and the heritage process is from father to sons only. |
| | Trading: This activity as gained importance in the last few years as a result of decrease in crop production and the need to get money to buy day to day products. it is done both within and outside the community. Trading includes also alcoholic | Men travel to the main village (about 17km away) to buy products that they sell in the community. | Women are in charge of selling products from their farms but due to the low productivity they are forced to abandon it. Bread-based alcoholic drinks are the main product being commercialised by women in this community. The profits are enough to sustain the families | Both men and women have access to this activity, but men are the one that control it. All the profits from the trading activity are controlled by men. Since most of the households are women headed, the control over this activity is being taken over by women. |



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**Table 1 continued**

| | | | |
|---|---|---|---|
| drinks that have gained popularity lately. | | | |
| Migration: this activity has increased drastically in the last few years due to the degradation of environmental conditions. More than 50% of the households are women-headed. | Men are the only members of this community that migrates to either south Africa or other places in the country in search of jobs and other sources of income | No role in this activity | Men are the only ones that have both access and control over this activity. They decide when and where to go and also when to return. Some just disappear. The destiny of the profits is decided by men. |
| Charcoal production: charcoal seen as one major source of income but at the current levels of forest degradation it is not sustainable. | Men's are exclusively in charge of this activity (production and selling) | No role in this activity | Men are the ones with access and control over this activity. They decide where to produce, which species to use and where to sell. |
| Firewood, water and fruits: firewood is the main source of energy in the community, while fruits have gained higher importance lately due to low crop production | No role in this activity | Women are exclusively in charge of this activity. | Women have access and control over this activity. They usually do it close to the houses but according to most of them the distances are increasing. |
| Beer brewing (local trade): this is a new activity that women have been involved with for the last 2 years. They buy bread and brew a beer which they sell locally. | No role in the preparation and/or selling but the biggest consumers of this product | Women are in charge of this activity. | Women have the complete control over this activity. |

Source: Ribeiro and Chaúque, (2010)



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**Climate Vulnerability and capacity analysis (CVCA) by CARE International: Southern Thailand experience**

The analysis underlines the need to pay special attention to the marginalised, who are more at risk and less able to adapt to climate variation challenges. CARE recognizes that, within their climate vulnerability and capacity analysis of the Southern Thailand, there was the need to ensure that the different roles and responsibilities of men and women are considered when addressing vulnerability, with a particular focus on women. Especially with respects to the impact of increased workloads, and the need to increase access to information and data, particularly with cross cutting age disaggregated data.

Whilst there was a strong recommendation on actions to move forward in enhancing climate and disaster resilient livelihoods, gender mainstreaming is not explicitly addressed within the specific analysis, and it would be interesting to see how gender plays a role in the identified vulnerable groups, such as 'fishermen, farmers, elderly and children'.

**Gender Dimension of Vulnerability to Climate: Empirical evidence of Smallholder Farming Households in Ghana**

Alhassan, Kuwormu and Osei- Asare, (2019) conducted a study to assess the vulnerability of male-headed and female-headed farming households to climate variation by using the livelihood vulnerability index (LVI) and tested for significant difference in their vulnerability levels by applying independent two-sample-student's t-test based on gender. The authors noted a significant difference in the vulnerability levels of female-headed and male-headed farming households. Female–headed households were more vulnerable to livelihood strategies, socio-demographic profile, social networks, water and



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food major components of the LVI, whereas male-headed households were more vulnerable to health. The vulnerability indices revealed that female–headed households were more sensitive to the impact of climate variation. However, female-headed households have the least adaptive capacities. In all, female-headed farming households are more vulnerable to climate variation than male-headed farming households. The researchers suggested that female-headed households should be given priority in both on-going and new intervention projects in climate variation and agriculture by empowering them through financial resource support to venture into other income-generating activities. This would enable them to diversify their sources of livelihoods to boost their resilience to climate change and variability.

A pervious study carried out examined the gender dimension of vulnerability of smallholder farmers in Ghana by using the livelihood vulnerability framework. It was revealed that female subordination in northern region of Ghana has been profound to warrant a study on gender dimension in relation to climate variation, especially as it is a semi-arid region with unpredictable climatic conditions.

**Strengthening Gender Considerations in Adaptation Planning and Implementation in the Least Developed Countries: Experiences from the National Adaptation Programmes of Action (NAPA)**

In Nepal, India as in many Asian countries, women are already in frontline of vulnerability on climate variation, with increasing floods and drought impacting their livelihood. Nepal’s NAPA acknowledges women are recognised as a vulnerable group. It emphasis on how to address gender dimensions of climate variation impacts for appropriate gender friendly and



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inclusive actions for adaptation and mitigation. The NAPA project profiles generally target vulnerable groups and communities and recognise that climate variation impacts affect poor communities more severely and also highlight the importance of gender mainstreaming. Besides the NAPA, Nepal also has a Local Adaptation Plan for Action (LAPA), which is considered as an answer for institutionalised local-level adaptation planning that aims to capture local needs and direct resources to where, when and by whom these are most needed. The LAPA implementation focused on socially marginalised and indigenous group and women with respectively 54% and 42% of actions directed to them. Moreover, due to the advocacy work on integrating climate adaptation actions into local planning process, fourteen (14) programme districts adopted adaptation actions into their local planning process. Participation of women is actively promoted in district and village level coordination committee that makes decision on local adaptation actions.

In Mauritania the National Adaptation Programme of Action is on equality between men and women, noting that climate variation will have different impacts on men and women, and in most cases, the adverse effects of the variation disproportionately affect women. For example, with the increasing frequency of drought experienced in Mauritania, it is women who have to walk longer distances to collect water and firewood or develop new income-generating activities, such as weaving and tie-dyeing. Women are often the chief guardians of vital local and traditional knowledge. Thus, they need to be recognised as key stakeholders in the consultation and decision-making processes, even though they have not been represented in great numbers. The objective of Mauritania's first NAPA project approved for implementation is



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improving the living conditions and incomes of women and young people in a sustainable way by developing agricultural value chains.

**Analytical Frameworks for Assessing Gender Dimensions of Adaptation to Climate Variation and the Conceptual Framework for the Study**

This section presents reviews of five (5) models that were used to study gender and the adaptations to the effects of climate variation. These are the Harvard framework for gender analysis, the Capacity and Vulnerability framework, the theoretical frameworks proposed by Eisenack and Stecker (2012), the IFPRI (2012) model and Babugura, (2010) gender-based of vulnerability and adaptation to climate variation model. It then describes the comprehensive frameworks that informed the evolution of a much suitable research design and methods for assessing the adaptations to the effects of climate variation from gender perspective.

**The Harvard Analytical Framework for Gender Analysis**

The Harvard Analytical Framework often referred to as the Gender Roles Framework or Gender Analysis Framework was published in 1985. The Framework was designed to perform gender analysis by demonstrating that there is an economic case for allocating resources to women as well as men and also by emphasizing the importance of better information to meet the efficiency/equity goal. It does this by mapping the work and resources of men and women in a community and highlighting the main differences. The analytical module is a matrix of four main components or tools:

1. *Activity profile*
2. *Access and control profile*



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3. *Influencing factors*
4. *Project cycle analysis*

The following provides a discussion of the four tools of the framework

***The activity profile***

This tool (Table 2) identifies all relevant productive and reproductive tasks and answers the question: who does what? For instance, within the context of the present study, will include a list according to the gender division of labour of the agricultural activities (such as land clearance, preparation, weed management, harvesting, and marketing) for cassava cultivation, or each type of field. Other parameters to be examined may also include:

- Gender and age denominations: identifying whether adult women, adult men, their children, or the elderly carry out an activity;
- Time allocation: specifying what percentage of time is allocated to each activity, and whether it is carried out seasonally or daily;
- Activity locus: specifying where the activity is performed, in order to reveal people's mobility. Is work done at home, in the family field, the family shop, or elsewhere (within or beyond) the community?



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**Table 2: Activity Profile Matrix**

| Activities | Women/girls | Men/boys |
|---|---|---|
| Production Activities<br>Agriculture | | |
| Activity 1 | | |
| Activity 2, etc. | | |
| Income Generating: | | |
| Activity 1 | | |
| Activity 2, etc. | | |
| Employment: | | |
| Activity 1 | | |
| Activity 2, etc | | |
| Other: | | |

Source: Adapted from: Overholt, Anderson, Cloud, & Austin (1985).

Note: within the context of the present study children (boys and girls) and adolescence below the age of 18 years were exempted since that constitute child labour which is against the labour law.

***The access and control profile: resources and benefits***

This tool (Table 3) enables users to list what resources people use to carry out the tasks identified in the activity profile. It indicates whether women or men have access to resources, who controls their use, and who controls the benefits of a household's (or a community's) use of resources. Access simply means that you are able to use a resource; but this says nothing about whether you have control over it. For example, women may have some access to local political processes but little influence or control over which issues are discussed



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and the final decisions. The person who controls a resource is the one ultimately able to make decisions about its use, including whether it can be sold.

**Table 3: Access and Control Profile**

| | Access | | Control | |
|---|---|---|---|---|
| | ***Men*** | Women | ***Men*** | Women |
| **Resources** | | | | |
| Land | | | | |
| Equipment | | | | |
| Labour | | | | |
| Cash | | | | |
| Education or training, | | | | |
| Other | | | | |
| **Benefits** | | | | |
| Outside income | | | | |
| Asset ownership | | | | |
| Basic needs (food, clothing, shelter, etc) | | | | |
| Education | | | | |
| Political power/prestige | | | | |
| Other | | | | |

Source: Adapted from: Overholt, Anderson, Cloud, & Austin (1985).

***Influencing factors***

This tool (Table 4) allows the determination of the factors which influence the differences in the gender division of labour, access, and control as listed in the two Profiles (activity and access and control profiles). Influencing factors include all those that shape gender relations, and determine different opportunities and constraints for men and women. These factors are far-reaching, broad, and interrelated. They include:

- community norms and social hierarchies, such as family or community forms, cultural practices, and religious beliefs;
- demographic conditions;



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- institutional structures, including the nature of government
- bureaucracies, and arrangements for the generation and dissemination of knowledge, skills, and technology;
- general economic conditions, such as poverty levels, inflation rates, income distribution, international terms of trade, and infrastructure;
- internal and external political events;
- legal parameters;
- training and education and;
- attitude of community to development/assistance workers.

The purpose of identifying these influencing factors is to consider which ones affect women's or men's activities or resources, and how they, in turn, can affect them. This tool is intended to help identify external constraints and opportunities which should be considered in development planning interventions. It should help in anticipating what inputs will be needed to make the intervention successful from a gender perspective.

**Table 4: Influencing Factors**

| Influencing Factors | Constraints | Opportunities |
|---|---|---|
| Community norms and social hierarchy | | |
| Demographic factors | | |
| Institutional structures | | |
| Economic factors | | |
| Political factors | | |
| Legal parameters | | |
| Training | | |
| Attitude of community to development interventions | | |

Source: Adapted from: Overholt, Anderson, Cloud, & Austin (1985): Gender Roles in Development Projects.



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***Checklist for project-cycle analysis***

This consists of a series of questions designed to assist in the examination of an areas of intervention from a gender perspective, using gender-disaggregated data and capturing the different effects of social change on men and women.

**Limitations**

The Harvard analytical framework was developed from an efficiency perspective, rather than an equity perspective. It was designed not so much to create more balanced gender relations, but to allocate new resources in such a way as to increase the efficiency of the project or programme. The Harvard Analytic Framework therefore gives no guidance on how to address challenges of existing inequalities. Neither does it draw out power dynamics, show the relationships between different people, or how people bargain, negotiate interests, make decisions, and so on.

It emphasise separation rather than connectedness and inter-relationships between individuals and groups. The Harvard analytic framework concentrates on the activities and resources of different categories of people, rather than on relationships between different groups. This leads to an emphasis on men and women, old and young, as separate groups with different and separate activities. However, the inter-relationships between them, and the forms of household and community co-operation and exchange are not examined. For instance, in exchange for his wife's labour on his fields, a husband may be obliged to pay her wages or to work on her fields in return. The exchange may be less direct. In return for giving a male relation control over a



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loan which is in her name, a woman may increase her status, or be more secure in times of the hunger gap.

Decision-making processes may be much more complicated than those represented in the matrix. Looking only at production cycles, and access and control over resources does not give a full picture of the negotiations and decision-making processes over key stages. Consider a case where producers sell their wares to an intermediary, who gives them a very low price for the goods. It may seem obvious to take over and replace the intermediary, and offer a better price. However, it may also be the case that the intermediary offers the producers informal patronage and support in times of hardship, such as credit or employment opportunities. This connection would not be visible in the Harvard framework but any attempt in these circumstances to replace the intermediary without considering this patronage is likely to fail.

Issues of power are not made explicit. The framework does not ask how and why gender relations are unequal; and so issues of power distribution are not drawn out. Because the way in which men and women relate to each other is not examined, the underlying causes of women's subordination are often not tackled. It is too materialistic, by concentrating on material resources rather than relationships between people, the Harvard framework takes tangible considerations as its starting point for analysis. It tends to assume that people make rational choices based purely on material considerations, thus leaving out some crucial motivational factors and constraints, such as community dynamics and cultural values.



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**Vulnerabilities and Capacities Analysis (VCA)**

This tool was originally developed in the 1980s to make relief interventions more developmental, since then the model has been used widely in other disaster and development contexts, and many other VCA methods have built on it. In the context of the VCA (Table 5), immediate needs are often addressed by short term, practical interventions (for example relief food). Addressing vulnerabilities in contrast, requires longer term strategic solutions which are part of development work.

For instance, those who experience regular flooding /mud-slides/earth quakes may have needs for temporary shelters and medical attention. On the other hand, their vulnerabilities are linked to those factors which directly contribute to the suffering caused by the event (lack of disaster preparedness programs/social inequalities perpetuated by gender and other forms of exclusion). The basis of the VCA framework is a simple matrix (Table 5) for viewing people's vulnerabilities and capacities in three broad, interrelated areas.

**Table 5: Vulnerability and capacity analysis matrix**

| Sector | Capacities | Vulnerabilities |
|---|---|---|
| **Physical/material**<br>What productive resources, skills and hazards exist? (Includes land, climate, environment, health, skills and labour, infrastructure, housing, finance and technologies) | | |
| **Social/organisational**<br>What are the relations and organisation among people? (Includes formal political structures and informal social systems) | | |
| **Motivational/attitudinal**<br>How does the community view its ability to create change? (Includes ideologies, beliefs, motivations, experiences of collaboration) | | |

Source: Anderson & Woodrow (1990). A manual for training in capacities and vulnerabilities analysis.

Thus the objectives of the VCA are to:



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- identify vulnerable groups;
- identify the factors that make them vulnerable and how they are affected;
- assess their needs and capacities (and empower them to assess these); and
- ensure that projects, programmes and policies address these needs, through targeted interventions or prevention and mitigation of potentially adverse impacts.

The following provides detail discussion of the set of interrelated concepts underpinning the VCA framework.

The VCA is designed on the premise that people's existing strengths (or capacities) and weaknesses (or vulnerabilities) determine the impact that a crisis has on them, as well as the way they respond to the crisis.

Vulnerabilities from the context of the VCA refer to the long term factors which weaken people's ability to cope with the sudden on-set of disaster, or with drawn-out emergencies. They also make people more susceptible to disasters. Vulnerabilities exist before disasters, contribute to their severity, make effective disaster response more difficult, and continue after the disaster.

Capacities on the other hand refer to the existing strengths of individuals and social groups. They are related to people's material and physical resources, their social resources, and their belief and attitudes. Capacities are built over time and determine people's ability to cope with crisis and recover from it.

Within the framework three categories of Vulnerabilities and Capacities are identified. These are, physical or material, social or organizational and motivational and attitudinal vulnerabilities and capacities.



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***Physical or material Capacities and Vulnerabilities***

These include features of the climate, land, and environment where people live, or lived before the crisis; their health, skills, their work; their housing, technologies, water and food supply; their access to capital and other assets. All of these will be different for men and women. While women and men suffer material deprivation during crisis, they always have some resources left, including skills and possible goods. These are capacities which agencies can build upon.

Key Questions to consider:

- What were/are the ways in which men and women in the community were/are physically or materially vulnerable? (or are the vulnerabilities and capabilities same for different groups of men and women in?)
- What productive resources, skills, and hazards existed / exist? Who (men and/or women) had/have access and control over these resources?

***Social or organizational capacities and vulnerabilities***

This category refers to the social fabric of a community, and includes the formal political structure and the informal systems through which people make decisions, establish leadership, or organize various social and economic activities. Social systems include family and community systems, and decision making patterns within the family and between families.

Gender analysis in this category is crucial, because women's and men's roles in these various forms or organization differ widely. Decision making in social groups may exclude women or women may have well developed systems



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for exchanging labor and goods. Divisions on the basis of gender, race, class, or ethnicity can weaken the social fabric of a group, and increase its vulnerability. Key questions to consider are:

- What was the social structure of the community before the disaster, and how did it serve them in the face of this disaster?
- What has been the impact of the disaster on social organization?
- What is the level and quality of participation in these structures?

***Motivational and attitudinal capacities and vulnerabilities***

These include cultural and psychological factors which may be based on religion, on the community's history of crisis, on their expectation of emergency relief. Crisis can be a catalyst for extraordinary efforts by communities, but when people feel victimized and dependent, they may also become fatalistic and passive, and suffer a decrease in their capacities to cope with and recover from the situation. Their vulnerabilities can be increased by inappropriate relief aid, which does not build on people's own abilities, develop their confidence, or offer then opportunities for change.

Key Questions to consider are:

- How do men and women in the community view themselves, and their ability to deal effectively with their social / political environment?

What were people's beliefs and motivations before the disaster and how has the disaster affected them? This includes beliefs about gender roles and relations.

Do people feel they have the ability to shape their lives? Do men and women feel they have the same ability?



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VCA considers a wide range of environmental, economic, social, cultural, institutional and political pressures that create vulnerability. It provides an approach that define information needs as well as structure data analysis. The framework emphasise what can and should be done to reinforce (and/or supplement) local management of response. It help move from assessing needs to understanding their causes and facilitate planning based on a vision of people as actors or even resources at the collective level of the family or community.

Five other factors can be added to the basic matrix to make it reflect complex reality. These are disaggregation by gender; disaggregation by other differences (for example, economic status); changes over time; interaction between the categories; and different scales or levels of application (village or national levels). This should be clearly identified at an early stage, to facilitate planning the VCA's scope and focus, identifying stakeholder participants and selecting data collection and analysis methods. VCAs can be carried out on almost any scale, from household and community to national and even international level. Complementary VCAs at different levels could also be considered. They can focus on many different sectors or dimensions of development (for example agriculture and food security, education, gender, transport, trade, disaster reduction).

**The International Federation of Red Cross (IFRC) – VCA**

The International Federation of Red Cross (IFRC) experience over the years has enabled it to refine and improve VCA to make it better focused and more effective in achieving its purpose. The IFRC VCA divides threats, vulnerabilities, and capacities into three categories:



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Potential threats:

- "Those based in nature: such as earthquakes, cyclones, droughts, floods or pathogens
- Those based in violence: such as war, intimidation, harassment or sexual assault
- Those based in deterioration: such as declining health, education and other social services; trade shifts; government policy or environmental degradation"

*Vulnerabilities:*

To determine who are the most vulnerable and why some are more affected, the following factors come into play:

- "Proximity and exposure: People who live or work on or near some kind of threat face a higher risk than those who do not.
- Poverty: People who have few options, few resources and few reserves cannot well protect themselves from threats.
- Exclusion/marginalisation: People who are left out of economic and social systems are vulnerable."

*Capacities and strengths*

These correspond to the same three categories used in CVA:

- Physical and material
- Social and organisational
- Skills and attitudes

**Limitations**

While it has been encouraging to note the strong interest in VCA by the disaster community in recent years, there is a danger of false assumptions being

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made that VCA can apply in all geographical situations and to all hazards. One of the underlying assumptions is that there is a 'community' ready to assess. However this may not always be the case. For example in the growing number of vast urban conurbations, the rapid turnover of residents prevents the growth of stable communities. Indeed, the very term 'community' can prove to be a myth for many urban dwellers and, thus, challenges the notion of community risk assessment and community-based risk reduction.

A further limitation is to recognise that VCA may need to have a low priority concern in relation to certain conditions. For example in assessing seismic vulnerability social considerations are not the primary area of concern. Since 98% of all earthquake deaths and injuries occur as a result of buildings, it follows that the key vulnerability and capacity issue relates to an assessment of the physical vulnerability of buildings and human settlements (Ian, Bruno & David, 2004). How people relate to buildings in terms of patterns of occupancy and density and their means of escape may thus become secondary considerations.

Another limitation is the gaps in the assessment methodology need to be addressed. These include the lack of an agreed set of indicators of social vulnerability and a lack of understanding and practical experience concerning ways to merge data from a social VCA with other sectors of vulnerability.



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**Table 6: Example of VCA Matrix- Key Questions and Gender Analysis Methods/Tools**

| | VULNERABILITIES | CAPACITIES |
|---|---|---|
| **PHYSICAL / MATERIAL** | *Examples* | *Examples* |
| DEFINITION: The productive resources, skills and hazards that exist<br><br>*Key Questions:*<br>What were/are the ways in which men and women in the community were/are physically or materially vulnerable?<br><br>What productive resources, skills, and hazards existed / exist? Who (men and/or women) had/have access and control over these resources?<br><br>*Method:*<br>Activity Profile<br>Access/Control Profile | Overall more marginalized women die than men<br><br>Women bearing burden of caring for sick<br><br>Time Poverty: e.g.<br>More work in field due to drought and untimely rainfall.<br>Increasing forest fire – loss of fodder, fuel wood.<br>More incidences of pests/weeds.<br>More time for collection of water.<br>Less time to seek medical help.<br>Increase in calorie deficiency. | Knowledge and experience –<br>Use of medicinal plants for family care;<br><br>Food and water management – storage, preservation, economize.<br><br>Increase in tasks for family care<br><br>Adapting agricultural practices/switching to other crops<br><br>Adapting diet |



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**Table 6 continued**

| **SOCIAL / ORGANIZATIONAL** | *Examples* | *Examples* |
|---|---|---|
| DEFINITION<br>Social Relationships between people<br><br>Their organizational structures<br><br>*Key Questions*:<br>What was the social structure of the community before the disaster, and how did it serve them in the face of this disaster? | | Women's user groups, networks<br><br>Leadership skills<br><br>Local knowledge of forest (as daily/frequent users of forest), agriculture |
| What has been the impact of the disaster on social organization? | Limited mobility | |
| What is the level and quality of participation in these structures? | Limited decision making in social groups (for example female unions/ groups, local council committees)<br><br>Male out-migration = women headed households | |
| *Method*:<br>Institutional Mapping<br>Time Line<br>Daily Activity Charts | | |



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**Table 6 continued**

| **MOTIVATIONAL / ATTITUDINAL** | *Examples* | *Examples* |
|---|---|---|
| DEFINITION: How the community views its ability to create change.<br><br>*Key Questions*:<br>How do men and women in the community view themselves, and their ability to deal effectively with their social /political environment?<br><br>What were people's beliefs and motivations before the disaster and how has the disaster affected them? This includes beliefs about gender roles and relations.<br><br>Do people feel they have the ability to shape their lives? Do men and women feel they have the same ability?<br><br>*Methods:*<br>Ethnographic tools (observation, open-ended interviews etc). | Increase in domestic violence against women<br><br>Suffering from conflicts over resources (marginalized groups and women face high exclusion - Women and men leaders practicing exclusive leadership<br><br>Limited time for education/training for income generation<br><br>Lack of participation in climate variation negotiations, planning and activities<br><br>Women-specific priorities neglected | Selling of assets and services – also opportunity to learn and use new technologies and techniques)<br><br>Social networks and groups<br><br>Organization of women<br><br>Women leaders from advantaged and marginalized groups |

Source: Authors' compilation from literature, 2016



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### The Eisenack and Stecker (2012) Model for Analyzing Adaptation to Climate Variation

The framework, developed by Eisenack and Stecker (2012) systematically describes the "actor-relations" involved in adaptations, and the barriers to their implementation. The framework (Figure 2) conceptualises adaptations as measures (actions) that encourage the acceptance of adaptation and clarify the different types of adaptation. The authors describe adaptations as actions and clarify the importance of the interrelationships between the actions leading to adaptations. Actions require actors and intentions. The intentions are directed towards the adaptations to the impact of climate variation. Adaptations require the use of resources as means to achieve the intended ends. According to Eisenack and Stecker (2012), actors can take different functional roles such as exposure unit or operator, or receptor of adaptation (Figure 2). A mismatch of these roles can lead to barriers to adaptation. Barriers however may develop from the complexity of actor networks, missing operators of adaptations, unavailable means, and means that are not employed properly although they are available (Figure 2). Eisenack and Stecker (2012), restrict themselves to the adaptations that are used by human actors, in contrast to, for example, adaptations through eco-systems.



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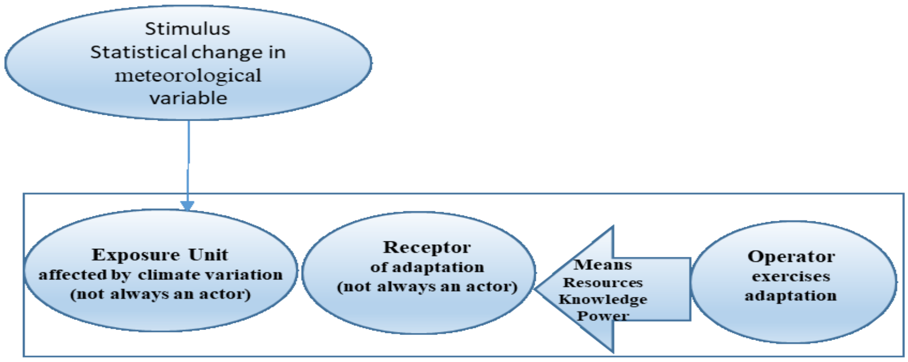


*Figure 2*: Schematic representation: action theory of adaptation

Source: Eisenack and Stecker (2012)

The following provides detail discussion of the set of interrelated concepts underpinning the action theory of adaptation model by Eisenack and Stecker (2012). In their model, a stimulus is defined as a change in biophysical in particular, bio-meteorological variables associated with climate variation. Stimuli refer to new statistical properties such as averages, intensity, higher momenta, or frequencies. Actions must be `actual´ but stimuli must necessarily be potential. They can also refer to abrupt large-scale events in the earth system such as changes in meteorological elements such as temperature and precipitation.

A stimulus is only relevant for adaptation when it influences an exposure unit. According to the action theory, the effects of climate variation is the combination of stimulus and an exposure unit. More broadly, it can be a set of stimuli with an associated set of exposure units. For example, exposure to increased temperatures or heavy or erratic downpours (stimuli) by crops (exposure units), which subsequently affect yields of crops and of labour



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required by farmers to till the land (impact). The exposure units are those directly or indirectly affected by external stimuli.

In the action theory (Figure 2), the individual or actor that exercises the response is called the operator. Thus, an operator can be, for example, a firm, government agency or a private household. The actions of an operator are ultimately targeted at impacts.

The actor that is the target of an adaptation (the purpose), is called the receptor. Receptors can be both biophysical entities (the crops of farmers) and social systems (a farmer household), depending on the objective of analysis. It should however be noted that, the receptor of an adaptation is not necessarily an exposure unit. For example, in an early warning system, the operator is a public body that runs the system. It receives weather forecasts and transmits them to the public in an accessible way. The purpose of that adaptation is to reduce harm to individuals who might be affected by external stimuli (for example, farmers). The intention is to change behavior of farmers, making them the receptors.

There are many social phenomena that do not follow a purpose; hence cannot be referred to as actions, but mere processes. Processes are described as sequences of events in time that may occur to a biophysical, technical, or social entity or system (Weber, 1922). They can be framed as linked through causality or in a mechanistic way. Actions on the other hand, according to the action theory of adaptation framework, are a special case of social processes that additionally have a teleological component (Weber, 1922).



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Eisenack and Stecker (2012), explained that, to exercise adaptation, the operator needs resources, called the means (Figure 2). These, can be (1) access to financial or other material resources, (2) legal power, (3) social networks, (4) knowledge and (5) availability of information.

The authors further indicate that, actions are shaped by constraints and resources that cannot be controlled by the operator. These are called, the conditions (Parsons, 1937). For example, the primary means employed by the operator of an early warning system (Meteorological Agency, MoFA, Agric Extension Officers, radio or television stations) is the information that will be provided to the receptors (farmers). Further means required to facilitate the work of the operator (say Meteorological agency), are the public funding, and the education of the people running the system. The success or failure of the system (achievement of objectives) is dependent on the attitudes of the receptors toward the early warning system (condition). That is, do they actually listen to the forecasts? Do they trust the forecasts? Does information lead to behavior change? Another condition is the institutional and legal context. That is, is there stable funding for the sustainability of the system? Are operators liable if forecasts are incorrect?

Eisenack and Stecker (2012), differentiate between three notions of means that are: available means, employed means, and necessary means. Available means are those that are disposable by the operator, for example, prediction of drought by the meteorological agency, while the employed means are those parts that are actually used for specific adaptations (say, drought tolerant varieties). However, it does not imply that adaptation would necessarily be effective if available and employed means are present. Success requires the



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use of the necessary means. This calls for the sensitization of farmers on the benefits to be derived from the use of drought tolerant varieties to ensure their usage or policy directive. For example, it is possible to forecast elevated temperatures and erratic heavy downpours for a particular farming season (available means); there is also the possibility of the availability of heat and flood tolerant crop varieties (employed means). But to overcome or mitigate the possible adverse effects of the impending drought or heavy downpours does not only require accurate weather information and availability of drought or heat tolerant varieties, it also requires the use of weather resilient varieties by farmers (conditions). This explains the sensitisation of farmers about the benefits of weather resilient varieties (necessary mean) for their acceptance and usage. Thus although, both the available and employed means are present, adaptation will still not be successful, because of non-usage of drought tolerant varieties due to lack of education (necessary mean). For adaptation to be successful, certain means (other than just prediction of drought or heavy downpours and availability of climate resilient crop varieties) are required.

Based on the above concepts, the authors of the action theory of adaptation made further important characterisations. The authors indicated that the most straightforward adaptations should be those where the receptor of an action is an exposure unit at the same time. The purpose of the action is to improve the situation of a system that is affected by a climate stimulus. This may be referred to as direct adaptation. The early warning system is an example of a direct adaptation, since the receptors of the information are the farmers that are exposed to the extreme weather conditions. It is meaningful to consider actions where receptor and exposure unit are not identical. In that case,



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adaptations can be described as indirect, in the sense that the action is intended to enable the receptor to take certain measures, and only those are finally targeted at an exposure unit.

The authors of the action theory indicate that, operators and receptors may or may not be identical. When operators act with the purpose to change something for other actors or biophysical systems, it is called a facilitating adaptation (Hinkel, 2007). If the operator's purpose is to change something for himself or herself, then it can be called reflexive adaptation. For an adaptation that is both direct and reflexive, the operator, receptor and exposure unit, should all be identical. The early warning system is a facilitating adaptation, since it (meteorological agency, MoFA, research institutions) is distinct from the farmers who are the receptors of the adaptation.

Eisenack and Stecker (2012), demonstrate how the framework can be used to explain some other established concepts of adaptation and vulnerability. The authors of the IPCC distinguish between autonomous and planned adaptation (IPCC, 2007b). The precise meaning however is not clear. According to IPCC 2007b), autonomous adaptation is the adaptation that does not constitute a conscious response to climatic stimuli but is triggered off by ecological changes in natural systems, and by market or welfare changes in human systems while planned adaptation is the adaptation that is the result of a deliberate policy decision based on the awareness that conditions have changed, or are about to change, and that action is required to return to, maintain, or achieve a desired state. Füssel (2007) claims that, planned adaptation refers to the usage of information about future conditions. But Eisenack and Stecker (2012), think that is not the underlying difference.



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Eological changes in natural systems are typically considered as autonomous, while government programmes are planned (Eisenack and Stecker 2012). There are thus, at least, two further interpretations. The difference could be interpreted as being between adaptations as actions (as discussed in the action theory of adaptation framework) and mere processes that lead to improvements. Alternatively, the term “planned adaptation” could refer to the type of operator, that is, to the actor category involved. However, this seems problematic, since there is a broad spectrum of relevant entities to consider between biophysical entities and governments, for example, technical infrastructure, companies, markets, local authorities, educational institutions or NGOs. Where is the appropriate place to draw the line between actors that adapt in a “planned” and “autonomous” way? This would need to be defined with reference to the specific research context. Similarly, a distinction should be made between anticipatory and reactive adaptation. It is often specified by the temporal dimensions of adaptations (for example, Smit et al., 2000, Füssel, 2007).

According to Eisenack and Stecker (2012), the core of the distinction is the question of whether to take action in advance. One interpretation relates to the purpose of action that might lie in the future (Füssel, 2007). For some adaptations, there is a substantial time lag between employing the means for the adaptation and its effect. Then, an adaptation is reactive when it is meant to become realized in the present, while it is anticipatory when it is planned to come into effect only in the future. Alternatively, the distinction can be based on the means available to the operator, in particular only knowledge about the present and the past (reactive), or also assumptions about the future, for example from climate projections. Finally, adaptation can also be anticipatory in the



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sense of expectations about means that are available in the future. These two interpretations are not equivalent.

A classic IPCC typology of adaptations is provided by Carter, Parry, Harasawa and Nishioka (1994). They differentiate between infrastructural, legal and legislative, institutional, administrative, organisational, regulatory, financial, research and development, market mechanisms and technological adaptations. These are basically means categories that may also be associated with typical operator types. By construction, many terms of action theory of adaptation can be mapped to the clarifying questions of Smit et al. (2000). "Adaptation to what" characterizes the purpose of an adaptation in terms of an impact, that is a stimulus that affects a considered exposure unit. "Who or what adapts" asks for the operator, receptor, and their relation to the exposure unit. Finally, "how does adaptation occur" requires a description on how means and purpose are interlinked, and whether just processes, or even actions, are considered.

Eisenack and Stecker (2012), shed more light on the difficulties involved in defining vulnerability and adaptive capacity. When adaptive capacity refers to potential adaptation, it might be, in the simplest case, a measure for the available means. However, since it has been seen that the available means are not likely to completely explain the implementation of adaptations, adaptive refers to conditions as well. Confusion should be avoided between the statement that adaptive capacity enables adaptation on the one hand, and the statement that adaptations reduce vulnerability on the other hand. In the first statement, adaptive capacity considers means and conditions, while



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the second statement talks about facilitating adaptations where the operator is distinct from the receptor (the vulnerable system).

***Limitations of the Action theory of adaptation framework***

A serious shortcoming of the action theory of adaptation is how it fails to acknowledge distributional issues (Swift, 1993). Hence, overlooking the issues of gender and equity. The model classified human recipient of actions meant for adaptation (receptors) as being identical and fails to take into consideration the intrinsic differences of receptors that may have arisen due to certain social and biological factors. For example, the action theory of adaptation fails to recognise that human beings are either born male or female whose roles and responsibilities are shaped by social dynamics. It also fails to recognise that society comprises of groups with different levels of vulnerabilities. Thus, although, all the means required for a successful adaptation maybe present, there could still be some disadvantaged groups who are likely to miss out of a planned intervention due to distributional challenges, a situation that can pose a considerable barrier to successful adaptation. By failing to recognize distributional issues, equity is not addressed (Yaro, 2004). Yet this is central to coping and adapting to climate variation.

The present study addresses the distributional problem associated with the action theory of adaptation by introducing gender into the framework. The introduction of gender to address the issues of equity is meant to strengthen the analytical values of the action theory of adaptation for the presents study.

Although the model analyses adaptations to climate variation using a series of coordinated actions by actors within the environment, such



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transforming processes have been deemed too general to be useful for empirical work (Birkmann, 2006).

Another shortcoming of the framework is how it has restricted analysis of adaptations to that made by human actors leaving out for example, adaptations due to eco-systems which the human system can take advantage of. The focus on just human adaptation can be deemed to result in methodological individualism as expressed by Du Toit (2005). The Action theory of adaptation also fails to vigorously incorporate practices that deal with changes in environmental conditions.

**The Assets Enhancement Coping with Risks from Climate Variation Model by IFPRI (2011)**

The International Food Policy Research Institute (IFPRI) and Partners developed a framework (Figure 3) useful for examining adaptation to climate variation from a gender perspective (IFPRI, 2011). It provides a basis for examining how climate variation can cause different vulnerabilities for men and women. The framework, a product of a project on "Enhancing Women's Assets to Manage Risk under Climate Change: Potential for Group-Based Approaches", is set against a vulnerability background that includes a set of interrelated factors such as user characteristics, biophysical characteristics, information and technology, and institutional arrangements.



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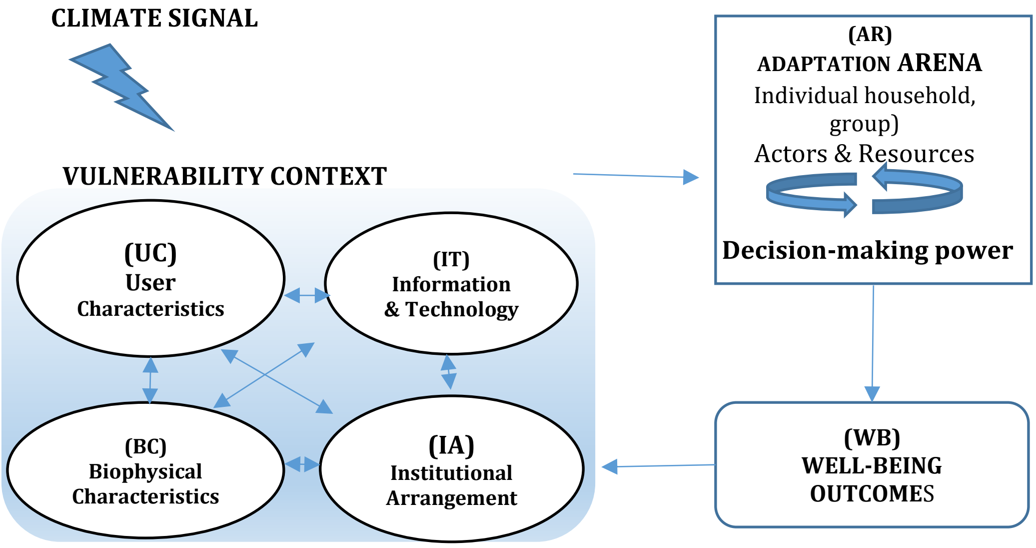


*Figure 3*: Assets enhancement for coping with risks from climate variation.

Source: Goh (2012)

The following provides a discussion on the set of interrelated factors in the IFPRI (2011) framework.

From the IFPRI (2011) framework, climate signal represents long-term changes in an average climate conditions, climate variation, or extreme weather event such as droughts, floods, or hurricanes which may affect actors within the vulnerability arena. The response of actors and systems depends on the characteristics of the climate stimulus, including the degree of exposure to the stress and the scale and magnitude of the event (Smithers & Smit, 1997). User characteristics (cell UC) is based on the fact that some individuals or groups may be more vulnerable to climate variation impacts due to their livelihoods, assets, sociocultural norms, and cognitive abilities or normative factors. For example, those who rely on natural resources for their livelihoods may be more exposed to the adverse effects of climate variation. In addition, the lack of resources or assets to adopt practices that would minimise their risks to climate



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variation could increase their vulnerability (Brouwer, Akter, Brander, & Haque, 2007; Gbetibouo, 2009; Deressa, Hassan, Ringler, Alemu, & Yesuf, 2009; Bryan et al., 2013). Differences in cognitive abilities or normative factors may also mean that men and women would interpret and respond to climate variation impacts differently.

The IFPRI framework, in addition to the user characteristics, displays some bio-physical characteristics (cell BC), institutional arrangement (cell IA) and information technology (cell IT) that interrelate with user characteristics to demonstrate the gender dimensions in the vulnerability and adaptation arenas which subsequently create different well-being for the different actors.

Biophysical characteristics within the framework such as agricultural systems represent sensitivity of the bio-physical or ecological systems to the impacts of climate variation. Information and technology refer to information about climate risks and the appropriate response strategies required by stakeholders within the adaptation arena (cell AR) to address the adverse effects of climate variation impacts. Access to climate information and technologies for adaptation are essential to enable actors anticipate long and short–term risks and make the appropriate adjustments to increase their resilience. Institutional arrangements consider markets, laws, policies, and sociocultural norms that influence how people are affected by and respond to climate variation.

The adaptation arena comprises the actors or those who depend on a bio-physical or ecological system for their livelihood, resources such as information, technologies, and innovations necessary for adaptation to impacts of climate variation and the decision-making power with regard to actions such as who does what, when and how, who determines what to do, when and how -



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all leading to adaptation that may improve upon the well-being of those affected by climate variation.

According to the assets enhancing based approach, long-term changes in the average climate conditions or patterns, or extreme weather events may affect actors differently in terms of user's characteristic (cell UC), bio-physical livelihood sources (cell BC), institutional arrangement (IA) and access to information and technology (IT), within the vulnerability arena on one hand, and resources and decisions making powers within the adaptation arena (IA) on the other hand. This creates different well-being outcomes (cell WB) at different spatial and temporal scales (IFPRI, 2011).

Using the framework (Figure 3) to analyse gender differentiated impacts of climate variation, Goh (2012), indicates that a hypothetical example may be that, a climate signal such as drought that occurs in a rural agricultural environment may cause crops to fail (bio-physical characteristics). Crop failure may have greater consequences with gendered nuances for farmers based on the user characteristics, institutional arrangement and access to information and technology within the vulnerability arena. For example, failure of subsistence crops may prompt women to sell off assets such as small livestock or seek other means of generating income to provide for their families. Men's larger involvement in cash crop production may mean that they lose lots of income when these crops fail, hence they may temporarily migrate to other areas in search of other jobs. Farmers with smaller income base may be compelled to decrease its consumption which may affect the nutritional health of children or deplete their savings as a coping strategy affecting the well-being of the



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members of the household. This demonstrates gender-based impacts based on users characteristics (men, women and children) in the vulnerability arena.

Goh (2012) further emphasises that, those groups with larger asset base, increased access to information, or institutional support may be able to change farming practices or diversify their crops to better withstand drought conditions. Hence, the ability to adopt these adaptation strategies are different for women and men depending on the assets they have, their access to, or control of resources, and the sociocultural context which determines their rights, roles, and responsibilities.

According to Goh (2012), many factors influence how climate variation affects the adaptation and well-being of women and men. For example, households' power dynamics influences differences responses to climate shocks by men and women (Carr, 2008). The interdependencies, expectations, entitlements, and livelihood strategies that are established between women and men, among women and among men, and among individuals within a community create diverse effects of climate variation (Demetriades & Esplen, 2008; Crane, Roncoli, & Hoogenboom, 2011). In addition, social structures such as ethnicity, race, religion, and caste (Ahmed & Fajber, 2009) or demographics characteristics such as age, education, wealth, and family size (Deressa et al., 2009) further intersect with the gender dimensions. These factors constitute the institutional arrangements that women, men, and communities are part of in their daily lives, and which affect the way they perceive, understand, value, or respond to climate variation in the adaptation efforts (Roncoli, Crane, & Orlove 2009).



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***Limitations of the assets enhancement model approach***

Although, the conceptual framework for enhancing women's assets to manage risk under climate variations addresses the issues of gender in the management of climatic risk which was overlooked by the action theory for adaptation framework, it has the shortcoming of restricting adaptations to only human actors. The model, by IFPRI (2011) does not consider adaptations to climate change variation through eco-systems of which the human system can take advantage.

Another limitation of this framework as far as the present thesis is concerned, is its broad overview for analysisng gender issues in the context of vulnerability and the adaptation to the impacts of climate variation, making it difficult to be adopted wholly without modifications.

**The Babugura's (2010) Gender-Based Model for Assessing Vulnerability and Adaptation to Climate Variation Impacts**

Another model that became useful for the analysis of the present study is the Babugura's (2010) gender-based model. The model examines vulnerability and adaptations to climate variation impacts from gender viewpoint (Figure 4). It seeks to establish the interrelationship between gender, climate variation impacts, vulnerability and adaptation to climate variation.

The following is a discussion on the details of the Babugura's (2010) gender-based framework for evaluating vulnerability and adaptations to climate variation.

Gender (cell G) in the framework (Figure 4) refers to males and females in a community setting whose social attributes and opportunities associated to being male or female are socially defined and are learned through socialization



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process in the community (Office of the Special Adviser to the Secretary-General on Gender Issues and Advancement of Women (OSAGI, 2001)). Changes in the global climate (climate variation, cell CC) impacts the environment with gender implications which subsequently creates disparities in vulnerability for the gender groups (cell DV) depending on the livelihood sources and their adaptive capacities as men, women, children aged people living with disabilities. Gender disparities in vulnerability can also lead to gender difference in the impacts (cell GDI) of climate variation (Figure 4).

Differential vulnerability in the model comprises of three components which are exposure, sensitivity and adaptive capacity (IPCC, 2007b). Exposure refers to the presence of a climate hazard; sensitivity refers to responsiveness of a system to the climate hazard, and adaptive capacity refers to the ability of the system to change in a way that makes it better equipped to manage its exposure and sensitivity to climate hazards and or cope with adverse impacts (IPCC, 2001; USAID, 2007).

Gender disparities in vulnerabilities to climate variation impacts (cell DV) within the framework (Figure 4), are as a result of men and women social roles, and inequalities in access to and control of resources (financial and human) which are determined by legal and cultural norms, state institutions, and decision-making power in households and communities. The gender-based impact and vulnerability according to Babugura (2010) gives rise to disparities in priorities with respect to copping, adaptation and building of resilience.



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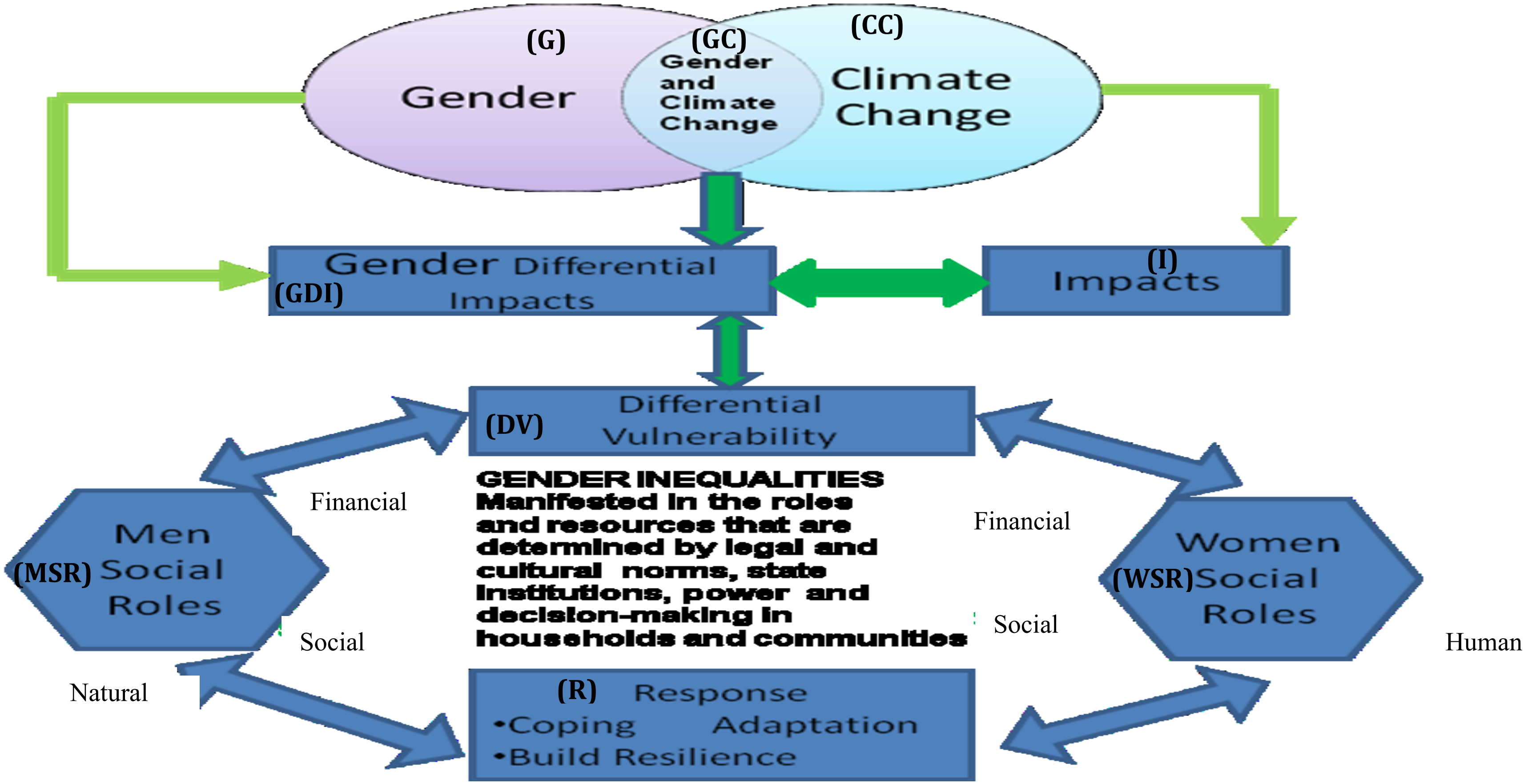


*Figure 4* Schematic representation of vulnerability and adaptation to climate variation from gender viewpoint

Source: Babugura, 2010



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Adaptation is key to enhancement of resilience of vulnerable systems (Stakhiv, 1993; Bohle et al., 1994; Smit et al., 2000; IPCC, 2001. According to Babugura (2010), resilience lies in the diversity of functional groups, accrued experiences, and memories that facilitate reorganisation following disturbances. It is therefore vital to understand the actions taken by each gender group that may help them moderate, cope with, or take advantage of actual or expected changes in changing climate conditions.

For coping and adaptation to be successful, and result to resilience, resources required to adapt to climate variation or change need to be equally accessible. These include access to land, credit, agricultural inputs, decision-making bodies, technology and training services, education, natural resources, mobility, access to equal economic opportunities, information and communication systems. With appropriate resources, women and men have the ability to develop complex adaptive strategies in order to build resilience to climate variation or change.

***Limitation of framework for analysing gender, vulnerability and adaptation to climate variation***

The framework analyses gender with respect to climate change, vulnerability and adaptation from a broad perspective. It refers to gender in the wider framework of the environment while the present study specifically targets males and females within the agricultural system at a specific location.

The analytical framework of Babugura (2010) puts much emphasis on gender-based impacts of climate variation within a broader scope of the environment whereas the present study seeks to examine adaptations to variations in climate from a gender dimension by tracing the adaptation pathway



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from gender differentiated impacts, which creates different vulnerability status for men and women cassava farmers in the agricultural system. Hence, require modification to make it appropriate for implementation within the context of the present thesis.

**Gender-Based Model for Assessing Adaptation to Climate Variations by Cassava Farmers.**

The framework evolved for the present study is "The Gender-based model for assessing adaptation to climate variation by cassava farmers". The model is based on the harvard framework for gender analysis, the capacity and vulnerability framework by Anderson and Woodrow, The Eisenack and Stecker (2012) theoretical framework for analysisng adaptation to climate variation, the Assets Enhancement for Risk Management Approach by IFPRI (2011) and Babugura, (2010) gender-based model for assessing vulnerability and adaptation to climate variation. These analytical tools and models were useful because they have assisted the present researcher in conceptualising the interrelationships between gender, climate variation impacts, vulnerability and adaptation to climate variation. They helped the establishment of the basis for examining vulnerability and adaptation to climate variation by farmers from gender perspective. The basic argument is whether the quality and sustainability of livelihoods depend on the strategies people develop in order to manage the adverse effects of climate variation on their livelihoods.

The above models were found not adequate enough to address the main focus of the present study, which is on adaptation strategies used by the cassava farmers in the Awutu Senya District in order to cope with the negative effects of climate variation on cassava production from gender perspective. The



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essence of the assessment is to determine whether adaptation strategies used by men and women to mitigate the effects of climate variations in the study area are driven by gender.

Notwithstanding their shortcomings, the analytical tools and models have been used as a starting point for evolving a model for data collection and analysis based on the objective, research questions and hypotheses.

To overcome the limitations of the reviewed models, agriculture which represents the biophysical variable that can be affected by climate variation is introduced into the adopted frameworks. In addition, cassava farmers have been incorporated as a subset of gender (males and females) in the environmental setting. The introduction of agriculture and cassava farmers within the reviewed frameworks strengthens their analytical values for addressing the core objective of the present study and gives rise to the elements of the new model contained in Figure 5. The new framework (Figure 5) provides the outline for the research process that gives coherence to empirical findings and analysis. It represents the foundation of the research from which data collections are determined.

Figure 5 shows the adaptations to climate variation pathways and the likely feedback relationships between gender, climate variation impacts, vulnerability, and adaptation to the effects of climate variation. These feedback relationships demonstrate how the impacts of climate variation on agriculture can have gender implications for cassava farming. The framework establishes the interrelationship between gender and vulnerability to climate variation which is defined by males and females' social roles, power, socio-cultural norms and institutional arrangements.



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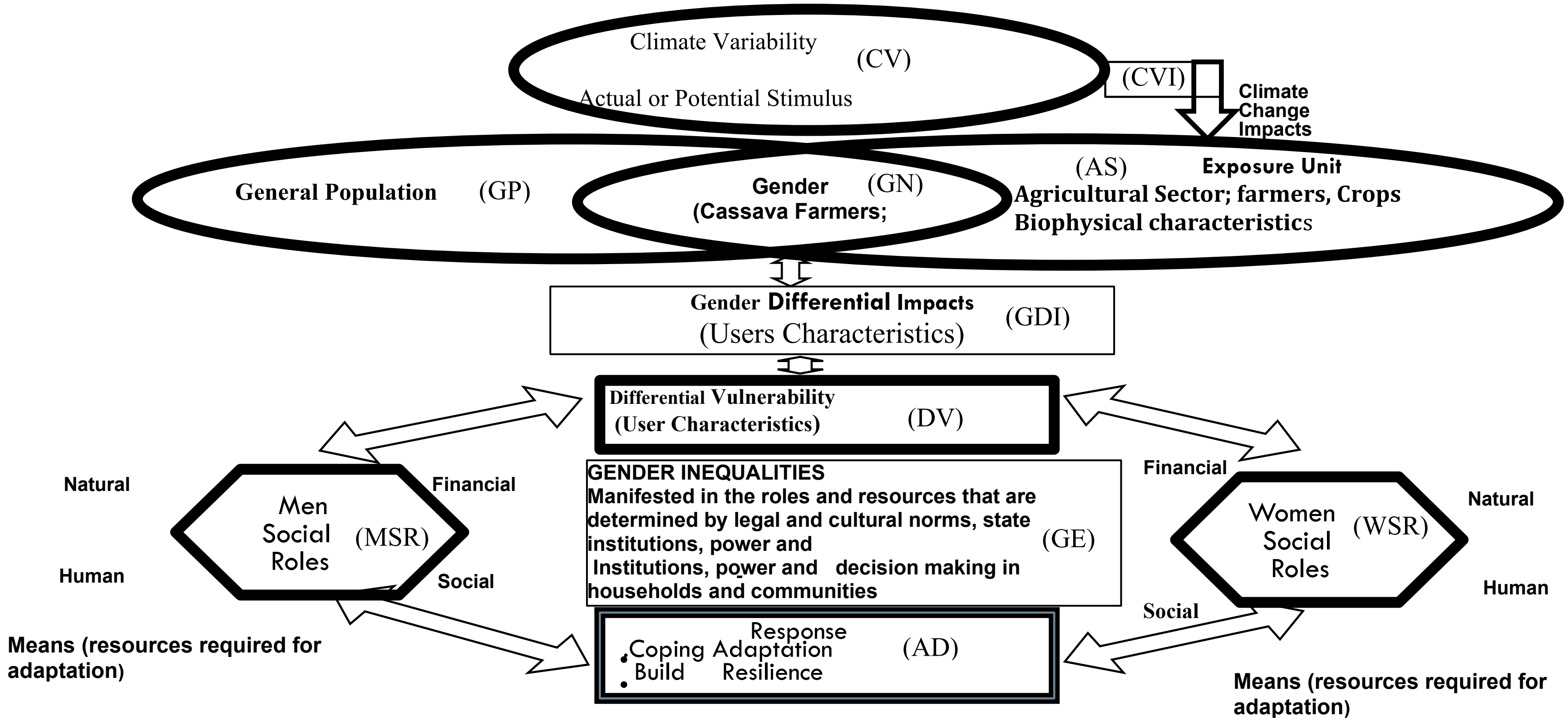


*Figure 5*: Gender-based model for assessing vulnerability and adaptation to climate variation by cassava farmers.

Source: Author's adaptation based on Babugura, (2010); Eisenack and Stecker. (2012) and IFPRI (2011).



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The following is a discussion on the details of the gender-based framework for assessing vulnerability and adaptations to climate variation by cassava farmers.

As shown in Figure 5, climate signal (CV) triggers external stimulus (CVI) that affects an agricultural system (AS). This is referred to by Eisenack and Stecker, (2012) as the exposure unit. The negative impacts of climate variation on agriculture have implications on crop yields, and on cassava farmers within AS (Goh, 2012; Eisenack and Stecker 2012).

The impacts of climate variation on cassava farmers may create gender-based impacts (GDI) and gender-based vulnerability (DV) as indicated by the VCA. The GDI and DV are attributable to user characteristics, gender inequalities (GI) and socioeconomic vulnerabilities (Commission on the Status of Women, 2008; Dennison, 2003; Dankelman, 2002; Denton, 2002; Goh, 2012). Gender inequalities are imbedded in formal and informal institution in society and power relations. Thus, the differences in the roles and responsibilities for males (MSR) and females (WSR), and the unequal powers, rights, opportunities, access to resources (means) and all the social attributes associated with being male or female as determined by legal and social institutions (OSAGI, 2001), are manifestations of gender inequalities.

Gender-based impacts to climate variation are linked with different vulnerabilities for the male and female cassava farmers as indicated in the evolved analytical framework (Figure 5). According to Babugura, (2010) males and females are bound by distinct socio-economic roles and responsibilities which create different vulnerabilities for each gender. The level of vulnerability is partly dependent on the biophysical characteristics of the exposure units and



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the user characteristics (crops and cassava farmers). The biophysical characteristics are determined by how sensitive the exposure unit (cassava crop) is to the climatic stimulus. The user's characteristics, on the other hand, are dependent on the ability or inability (adaptive capacity) of the individual (cassava farmer), or group (gender) to withstand stressful situations caused by climate variation due to lack of assets, sociocultural norms, or cognitive abilities and normative factors according to Harvard gender analysis matrix and VCA. As stated by Goh (2012), differences in cognitive abilities and normative factors may also mean that men and women would interpret (perception) and respond to climate variation impacts differently Again relative vulnerability or resilience of men and women farmers to similar shocks and stresses is determined through gender and power dynamics. Power dynamics and cultural values shape gender roles and division of labour (Babugura, 2010). Resources (including financial and human), rights, and livelihood options, open to males and females, and the varying capabilities of men and women are shaped by these dynamics and cultural values (Oxfam & UN, 2009). Thus, depending on the influences of these variables that include socio-economic roles, user's characteristics, power dynamics, resources, and cultural values, males and females may develop diverse coping mechanisms and adaptation strategies to withstand the adverse effects of climate variation.

The ability to develop effective adaptation strategies that can lead to resilience is dependent upon the availability of the means, which according to Eisenack and Stecker, (2012), are resources, opportunities, alternative choices, information, improved technologies, and institutional arrangements. Resilience provides mechanisms for restoration and reorganisation which are critical for



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adaptation (Gunderson and Holling, 2002, Berkes et al., 2002). Resilience is the opposite of vulnerability. Hence, the less resilient gender will become increasingly vulnerable to the impacts of climate variation.

Eisenack and Stecker (2012), have stated that, the most important means for successful adaptation are the necessary means which must be accessible to receptors. As such, access to the means for adaption is very important; but access is determined by power dynamics and cultural values, institutional arrangements, legal and social norms, which intern are influenced by gender (Oxfam, 2009). The lack of means or assets to adopt the practices that would minimise risks of climate variation impacts could increase vulnerability (Brouwer et al., 2007; Gbetibouo, 2009; Deressa et al., 2009; Bryan, Ringler, Okoba, Roncoli, Silvestri, & Herrero, 2013).

The adapted framework gave coherence to the conduct of the present study and outlined the data types, variables and structure of the data analysis. Based on the developed framework gender disaggregated data in climate variation impact and vulnerability was collected together with gender based perceptions of climate variations and the adaptation strategies adopted by each gender group to combat the effect of the variations in climatic elements from a gender perspective.

The Harvard gender analytical framework was employed in the determination men and women activities with regards to cassava farming (gender division of labour; initial clearing of land, planting, weeding, harvesting, and marketing of harvested produces). This was done through interviews with key informants and semi-structures questionnaires and focus group interviews or discussions. Based on the Harvard analytical framework,



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farmers were interviewed on the methods of land acquisition for farming activities, gender preference for education, gender based access to climate information, gender preferred information and the power dynamics (who determines what, where and when) involved in cassava farming. Influencing factors in determining, who does what and at what time, rights and opportunities available to a farmers based on gender was also determined with the use of the Harvard framework.

The vulnerability and capacity analysis tool facilitated in the determination of the factors that promoted gender based vulnerabilities, the capacities of the farmers as men, women, youth and aged to deal with climate variation impacts and beneficial opportunities available to be exploited for the purpose of reducing vulnerability in the face of climate variation on their farming activities. It helped in defining the information needs, available resources as well as structure data analysis. The tool was influential in arriving at the determination of the most vulnerable gender by identifying the gender with the limited capacity to adapt as a results of lack of access to resources and information.

In the context of the present study, in order to address the issues of gender perceptions about climate variation, data pertaining user’s characteristics such as educational background, marital status, social group affiliation and age of respondents were collected and analyzed. For gender-based vulnerabilities to the impacts of climate variation which are largely influenced by user’s characteristics, men and women social roles, access to natural, human, social and financial resources and information, data on access to land and climate information, household power dynamics and support from



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spouse was collected and analysed based on Goh (2012) and Babugura, (2010) theoretical model analyses. Issues on gender-based impact and adaptation, which are also related to user's characteristic, biophysical characteristics and access to resources (means) as demonstrated by Goh (2012) and Eisenack et al. (2012) were addressed by obtaining gender disaggregated data on climate variation impacts on cassava yields, effects on variation of income, access to climate smart technologies or cassava varieties, access to information and institutional support from both private and public agencies. The key variables involved here are; gender, climate variation impacts, perception, vulnerability and adaptation to climate variation.

Thus from an analytical point of view, in order to reduce the negative impact of climate variation such as drought on cassava production in the Awutu Senya district, it is imperative that the resource necessary to address the problem are available as espoused by Eisenack and Stecker, (2012). But according to Goh (2012) and Babugura, (2010), it is not sufficient for only the resources to be available and accessible. This is because for adaptation to be successful, there must be equity in the accessibility of the necessary resources. In addition to equity, resources must be appropriately employed by users (Eisenack & Stecker, 2012). Equity addresses distributional issues or inequalities between gender groups (Yaro, 2004). Hence data on the farming activities of respondents and access to resources were collected. For example gender disaggregated data on the type and characteristics of cassava with regards to their climate smartness cultivated by farmers were collected in addition to practices that would enhance yields in the face of climate variation.



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In order to address the issues of equity, gender-based information on access to resources such as land, climate information and credit was obtained. The underlining factors responsible for the disparity in access were also explored. For example, according Kurukulasuriya and Rosenthal, 2003, frequently, new agricultural technologies bypass women farmers by extension personnel introducing new varieties intended for higher drought or heat (Kurukulasuriya and Rosenthal, 2003). Furthermore, Patt et al. (2009) opine that different gender attitudes towards risks (user characteristics) exist where males are more likely to take risks in decision making processes, whereas females are more likely to seek and listen to advice, and learn from others who have more experience. Such intrinsic female tendencies make it easier for consulting agencies to offer help to females as they are more likely to take advice and carry out things that aid agencies suggest.

Aoyagi, Suda and Shinada (2011) have pointed out that although societies still have gender-bias tendencies in their social systems, many are trying to overcome them. Nonetheless, gender biases still exist in several rural settings especially in division of work.

## Summary

This chapter has explored the concepts of gender and impacts of climate variation from the relevant literature. The underlining theories to these concepts were outlined. The nexuses between gender, climate variation, vulnerability and adaptations have been explored. The role of gender in determining the vulnerabilities and adaptation strategies of those who rely on agriculture for their livelihood has also been examined. The discussion of the relevant literature



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on gender, climate variation and agriculture in Ghana has been presented. Finally, the chapter has reviewed relevant literature on some empirical studies done elsewhere and in Ghana and related conceptual frameworks. A review of the conceptual frameworks set the basis for the development of a new framework that comprehensively conceptualise adaptation to climate variation pathways from gender point of view.

It was observed from the literature that, individual farmer's vulnerability to the adverse effects of climate variation is related to their gender, and this gives rise to gender disparities in the adaptation strategies for coping with climate variation. According to the review, disparities in vulnerabilities between males and females are largely due to the social roles of males and females and to the unequal powers, rights, opportunities, access to resources in the society. All these lead to gender-based marginalization. Hence it is important to identify and take into account gender related vulnerabilities when adaptation measures are being developed and defused. A review of the analytical framework revealed that adaptations requires resources and capacities, while the ability to adapt to depends on the level of vulnerability. While some people may able to adapt due to the resources available to them others maybe incapacitated as a results of social and physical factors such as gender, cultural norms and belief systems, gendered social roles in formal and informal institutions, users characteristics and lack of capital, human and financial resources.

According to the analytical framework evolved for the present study, in order to ensure effective adaptations which may lead to resilience, gender equity has been stressed as being very crucial for resolving distributional issues, the lack of which could create barriers to successful adaptation. The new model



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tries to find an out if adaptation strategies used by the farmers are influenced by gender, and hence form a basis for a gender sensitive approach to solving the effects of climate variation on cassava production in the Awutu Senya District in Ghana. Gender equity, it is hoped, will most likely ensure policy strategies that may be developed in the future, are multifaceted, dynamic and responsive to the needs of the beneficiaries.



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# CHAPTER THREE

# METHODOLOGY

## Introduction

This chapter describes the research design, and the methods used to collect data for the study. The chapter also describes how farming communities in the study area were selected, and how respondents were selected to participate in the sample survey. The chapter finally highlights how the qualitative and quantitative data were analysed, and how issues relating to ethical considerations were covered. However, before these issues were examined, the description of the study area was provided.

## The Study Area

The research was conducted in four settlements in the Awutu-Senya District of the Central Region of Ghana (Figure 6). The towns are Awutu Breku (the district capital), Senya Beraku, Bawjiase, and Bontase. Awutu-Senya District is located on the eastern coast of the Central Region of Ghana. It is bordered by the Awutu Senya East Municipal and the Ga South Municipal of the Greater Accra Region to the east, Agona West District to the west, the West Akim District to the north and the Effutu Municipal and the Gulf of Guinea to the south.

The District is located in the dry sub-humid tropical climate zone of Ghana (Acheampong, 1987). The mean annual minimum and maximum temperatures are 23°C and 28°C respectively. It falls into the semi-deciduous forest in the north, and the coastal savannah grassland along the coast.



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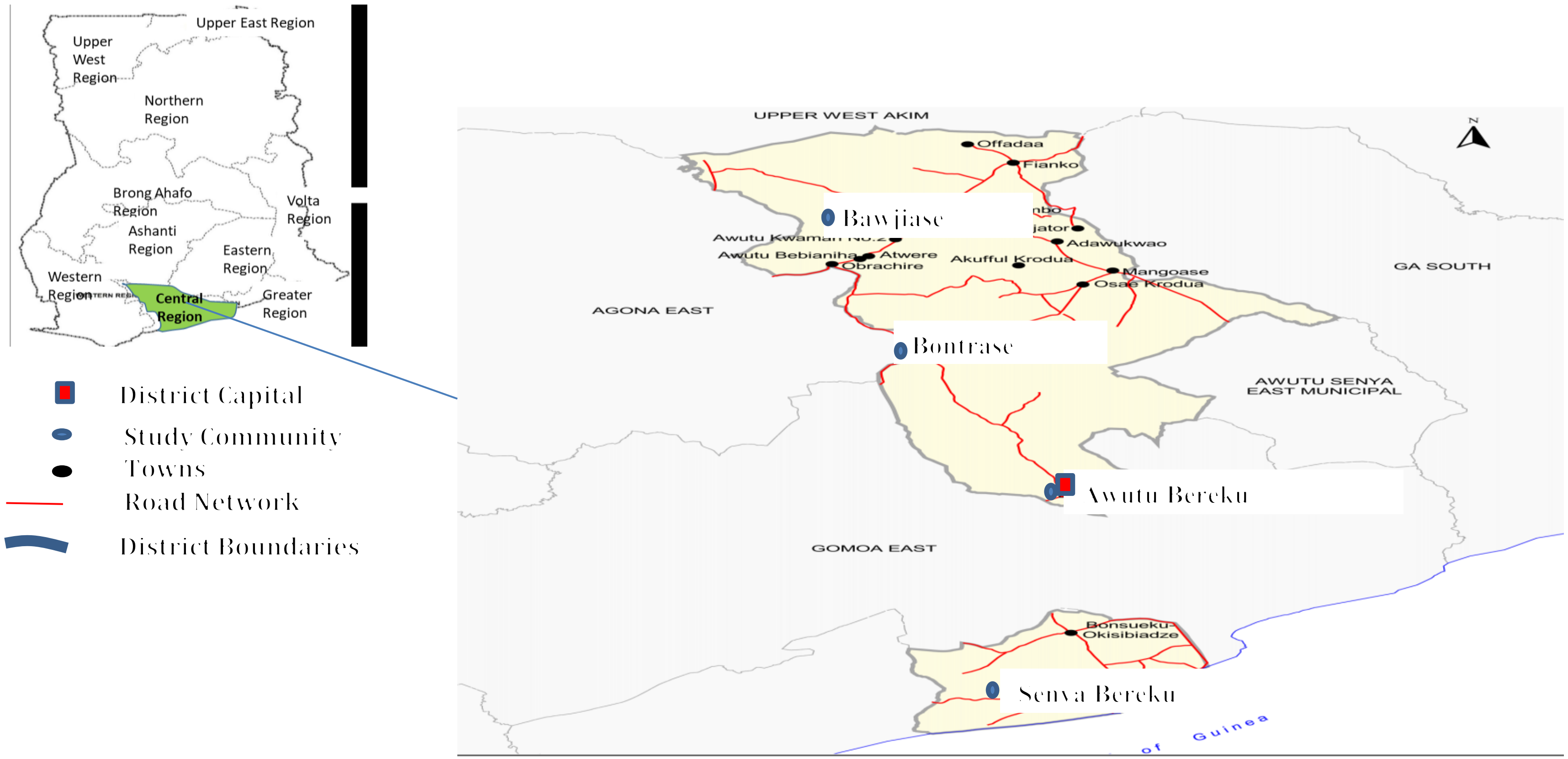


*Figure 6:* Map of Awutu-Senya district

Source: Ghana Statistical Service (2010)



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The study area experiences two seasons; the rainy and the dry seasons. The rainfall season which lasts from April to November is separated by a short-dry season in August -September. Rainfall is heavy but variable during the major rainfall season, during which period the moist South-West Monsoon blows across the area. The annual rainfall figures of the district are quite low (40cm-50cm) along the coast but are higher in the hinterland (50cm-70cm). The dry season starts from November and ends in March, during which period the dry harmattan winds prevail (Ghana Statistical Service (GSS, 2014)).

The topography of the area is undulating. The District is underlain by Birrimian rocks which consist of granites and phyllites. In the semi-deciduous forest zone of the district, the soil type is loamy-sandy which makes the place suitable for root and tuber crops farming. It supports the growth of crops such as pineapple, cassava, yam, maize and citrus (GSS, 2014). The soils found in the southern zone are characterised by clay, with high salinity and therefore do not support the cultivation of many crops, but provides opportunities for ceramic and pottery industries.

The population of Awutu Senya District, according to the 2010 Population and Housing Census of Ghana, is 86,884 which represents 3.9 percent of the region's total population. Males constitute 47.1 percent and females, 52.9 percent. The proportion of the population living in the urban areas is 48 percent.



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Almost half (48.3%) of the population above 11 years in the district is literate in English. About 75.1 percent of the population aged 15 years and above are economically active. About 95.7 percent of the economically active population is employed. For those who are economically not active, 52.3 percent are students (GSS, 2014).

The main economic activities in the district are agriculture, wholesale and retail trade, agro-processing, informal sector service, and commerce (MoFA, 2011). The District is a hub for agriculture and its related activities. Agriculture employs over 50 percent of households in the District. Agricultural activities include crop farming, tree planting, livestock rearing and fish farming (GSS, 2014).

The district is noted as one of the cassava producing areas in Ghana where both males and females are actively involved. For example, in 2010, The Awutu-Senya District produced 414,515 metric tonnes or 22% of the total cassava output of the entire Central Region. The district was the second highest producer of cassava in the country after the Nkwanta District of the Volta Region, which produced 564,874 metric tonnes of cassava that year (MoFA, 2012).

**Research Design**

The research design employed is the mixed method which was used to collect both quantitative and qualitative data. Though they have different epistemological backgrounds, qualitative and quantitative methods were combined to allow the deepening of understanding through cross-validation of



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data (Bell, Bryman & Harley, 2018). That is, the mixing of both quantitative and qualitative methods, provides gains in breadth and depth of understanding and corroboration of issues being studied, while offsetting the weaknesses inherent to using each approach by itself.

The basic rationale for this design was that, qualitative and quantitative methods contribute in different ways to the understanding of social issues, and each is good for answering different research questions. For example, the quantitative method was used to show the trends of the key climatic elements (rainfall and temperature; Figures 12, 13 and 14), and how their variations were perceived to have effect on cassava production in the study area (Figure 31). The qualitative methods were also used to explain how gender differences controlled perceptions and adaptation choices and hence helped to give greater confidence in the accuracy of the conclusions derived from the qualitative data (Silveman, 2001).

Another basis for the adoption of the mixed method design was that, the quantitative approach allowed for the measurements of descriptive statistics that outlined the study, and provided the basic information on the characteristics of the target population, while the qualitative approach helped in the understanding of the situation through the presentation of what respondents perceive about situations and the reasons for their perceptions (Patton, 2002). Many researchers (Creswell & Creswell, 2003; Thomas, 2003; Krathwohl, 1993), view qualitative and quantitative methods as complementary. As such the present thesis employed the mixed method to allow the convergence of qualitative and quantitative data, and to achieve comprehensive analysis of the research



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questions.

The approach also allowed for the elimination of the weakness associated with employing only the quantitative or qualitative approach. For example, a key weakness of the qualitative method is the difficulty in making generalization from findings obtained whilst though not quite flexible as qualitative approach, the quantitative method allows generalisation of results and predictions (Winchester & Rofe, 2005). As observed by Bell, et al (2018) the mixed-method enquiry is like combining two different and separate paradigms of research methods in one study.

The philosophical stance that guided the direction of the data collection, analysis and the use of the mixed method research design was pragmatism. The primary aim of the pragmatic approach was to examine particular phenomenon or situation by using those methods that were most appropriate (Yvonne Feilzer, 2010). For example, quantitative method was used to determine the more vulnerable gender perceived by the farmers to climate variation and also the relationship between gender and the choice of adaptation to variations in climate, while qualitative approach was adopted in identifying the underlining factors giving rise to gender-based vulnerability by analyzing the opinions, observations and beliefs of respondents in addition to the cultural norms of the study area in relation to the issue being studied.

One of the specific objectives of this study was to find out the more vulnerable gender to the effects of climate variation from the farmers' own points of view. To achieve this objective require the use of both statistical techniques and interpretative approaches. The descriptive statistics were



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employed to compare respondents' responses and their behavioural patterns with respect to their gender in quantitative terms, while conclusions about the population were drawn based on the interpretation of the inferential statistical results obtained from chi-square and symmetric test statistics.

In conformity with the research paradigm of pragmatism, both inductive and deductive research approaches were used. Inductive method, normally use the research questions to narrow the scope of the study and is concerned with the generation of new theories emerging from the data collected (Goddard & Melville, 2004). The deductive approach on the other hand was concerned with developing a hypothesis or hypotheses based on some existing theory, and then designing a research strategy to test the hypothesis (Wilson, 2014). Beiske (2007) opines that deductive research approach explores a known theory or phenomenon and tests if that theory is valid in a given context. The research method was concerned with coming into a conclusion from premises or propositions made.

Thus, in line with the inductive methods the researcher began with a topic, and then developed empirical generalisations through identified relationships between the variables under investigation. The inductive approach was used in the present study to perform a comparative analysis of male and female farmers perceptions about climate variation effects on cassava production, what triggers their vulnerabilities and how these vulnerabilities affected their adaptation to climate variation from a gender perspective in order to come to a generalization that there is no difference in the attitudes of men and women in relation to these variables or vice versa. This approach facilitated



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a clear understanding of how cassava farmers in the study area thought of, what influences their thinking, how they live their lives, and react to situations concerning climate variation.

The deductive method was also employed to uphold or dismiss the theory that there is no difference between male and female vulnerability to climate variation and the choice of adaptations adopted by each gender group. Relationships were established through the use of numerical estimations and statistical inferences based on the quantitative data of responses of male and female cassava farmers. Ultimately, the use of the inductive and deductive approaches were influenced by the desire to understand fully the relationship between gender and strategies adopted to overcome challenges brought about by climate variation.

With regard to the research procedure, a survey was conducted to gain in-depth understanding of gender dimensions on the adaptations to the variations in climate by cassava farmers in the Awutu-Senya District. Data were collected using structured and semi-structured questionnaires and interview guides. Published documents were consulted to obtain information relevant to the objectives of the study. The study was partly cross-sectional in nature; it measured aspects of the behaviour of the selected male and female cassava farmers at specific points in time. Data were processed and analysed using the International Business Machines Statistical Package for Social Science (IBM SPSS) Version 22 and Microsoft Excel 2013. The statistical tools were used to perform chi-square and symmetric test analyses. The statistical tools were also used to produce sample statistics such as means, and proportions of the various



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samples. Other outputs from the software such as frequency tables and diagrams such as, bar graphs, charts and trends were used to express the results of the data analysed.

**Target Population**

The target population consisted of male and female cassava farmers in the Awutu-Senya West District. These were the people whose livelihoods depended on cassava farming and highly susceptible to climate variation.

**Sampling Procedure and Sample Selection**

The unit of analysis was gender involving male and female cassava farmers. A three (3) stage sampling technique, the cluster sampling, the stratified sampling, the simple random sampling techniques and focus group method were used to select the desired sample for the study. With regards to the multistage sampling, the first stage involved the clustering of the 18 communities in the Awutu Senya District into 11 cassava growing communities. At the second stage, four communities were randomly selected from the 11 using the lottery method. The third stage involved the selection of samples from the four selected communities. Here, the simple random sampling technique was adopted. The randomisation ensured that each and every unit had an equal chance of being selected.

The multistage sampling technique has the advantage of considerably reducing the cost of operations of the survey and non-sampling errors by efficient supervision. Another key advantage associated with the multistage sampling technique is its high data reliability. It allowed the application of



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stratification and randomisation which reduced bias from sampling errors. Because the study involved the evaluation and classification of opinions from a gender perspective, it was very essential that the sample selected represented a broader gender groupings or facilitated comparisons among males and females. Thus, towns were clustered in such a way that selected respondents from such towns were the best possible samples in terms of occupation and gender.

After the four communities were randomly selected, the farmer population within each community was grouped (stratified) into male and female, with each gender group representing a stratum. Sample units were then drawn from each stratum based on the proportion of the stratum relative to the total size of the farmer population of a selected town. Stratifying the population by gender ensured that variations among sampling units within each gender group was lower compared to variations when dealing with the entire population. At the same time, between strata, there was a high degree of variability. For example, it has been established from the literature that males and females differ both in cognitive and normative abilities (Li, 2014). Similarities within stratum and variations between strata allowed for easy comparison of issues across gender groups. The application of stratification and proportional allocation ensured equitable representation of each gender in the study. Random selection of sampling units helped to improve the overall accuracy of result obtained from the collected data by ensuring that every sampling unit had equal chance of being selected.

Focus group discussions were held with cassava farmers divided into two groups based on gender (male and female). The gender-based groups were



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formed in order to obtain gender specific information within the context of the study and the driving forces fostering the gender-based behaviors. The focus discussions was also to foster a supportive environment for the discussions. This method assumes that an individual's attitudes and beliefs do not form in a vacuum: People often need to listen to others' opinions and understandings.

Two (2) key informants were purposively selected based on their in-depth knowledge about the climate of the study area and their wealth of experience in farming for over 30 years in the study area. Four key informants (2 males and 2 females) were initially listed on the sample frame. But during the field survey two of them (one male and one female) could not be interviewed because they had travelled out of their respective communities where the study was being conducted. With regard to sample selection, four out of eleven clusters of cassava farming towns in the Awutu-Senya West District were randomly selected. Farmers were selected from a sample frame of male and female cassava farmers in all the four towns. Due to time, resources, and cost constraints, the sample size was restricted to two hundred and fifty-two (252) respondents. The sample included two hundred and fifty (250) cassava farmers and two (2) key informants from a population of seventy-four thousand (74,000) cassava farmers and opinion leaders in the four communities. A very large sample size would have required several months to conduct the study. This, notwithstanding, the overall quality of the results was not affected by the selected sample size, since the sample selection procedures (randomisation and stratification) used, ensured that errors that would have resulted from the process of sample size selection were minimised.



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The sample size was determined within a 95% confidence interval, using the following expression: $n = \frac{X^2NP\times(1-P)}{(ME^2(N-1))+(X^2P(1-P))}$, where

n = sample size; $X^2$ = Chi-Square for the specified confidence interval at 1 degree of freedom; N = population size; P = population proportion and $ME^2$ = desired margin of error (Krejcie & Morgan, 1970). Table 1 below presents a summary of the selection process.

Table 7 presents the selection of respondents (sample) who participated in the study using proportional allocation based on stratified random sampling. As indicated in Table 7, Awutu Breku had 22,550 cassava farmers out of which 6,765, were females, and which represented 30% of the total farmer population of the town; Senya Beraku had 18,350 famers with 8,258 (45%) being females, Bawjiase had 21,230 cassava farmers with 10,190 (48%) being females while the fourth town, Bontase had a cassava farmer population of 11,870, of which 6,529 (55%) were females. Seventy-six (76) farmers were selected from Awutu Breku, made up of 53 males and 23 females. At Senya Beraku, a sample of 62 cassava farmers was selected. The sample was made up of 34 males and 28 females. At Bawjiase, 39 males and 33 females were selected, while from Bontase, 40 farmers, comprising 18 males and 22 females were selected. Two (key informants; Benjamin Amposah from Awutu Breku and Hannah Otchere from Bawjiase) were also selected to participate in the study. These gave an overall total of 252 respondents who were selected for the study. The total comprised 145 males and 107 females.



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**Table 7: Sample selection procedure and composition of selected sample**

| Town | Target Popln. | Male Popln (Stratum $N_m$) | Female Popln (Stratum $N_f$) | % of Male Farmers | % of Female Farmers | Proportional Allocation Selected Sample (by Town) | No. of Male Farmers | No. Female Farmers |
|---|---|---|---|---|---|---|---|---|
| Awutu Breku | 22,550 | 15,785 | 6,765 | 70% | 30% | 77 (including 1male Key Informant) | 53 | 23 |
| Senya Beraku | 18,350 | 10,093 | 8,258 | 55% | 45% | 62 | 34 | 28 |
| Bawjiase | 21,230 | 11,040 | 10,190 | 52.4% | 48% | 73 (Including 1female Key Informant) | 39 | 33 |
| Bontase | 11,870 | 5,342 | 6,529 | 45% | 55% | 40 | 18 | 22 |
| Total | 74,000 | 42,259 | 31,741 | 57% | 43% | 252 | 145 | 107 |

Source: Author (2016).



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**Data and Sources**

This study collected both quantitative and qualitative data through primary and secondary sources. The primary data was obtained through field work using sample survey, focus group discussions and interviews with key informants, while secondary data sources were from document, previous research, official statistics, mass media, government reports and website information.

**Data Collection Instruments**

Structured, semi-structured questionnaires and interview schedules were the instruments used to collect the data (Appendix B). Instruments were used concurrently to collect both qualitative and quantitative data. The questionnaires had both open-ended and close-ended questions. The structured questions were used to guide respondents to selects a response from a set of choices all of which fall within the domain of the research objective while the semi-structured questionnaire allowed for the respondent to provide elaborate information about the set questions with the help of the interviewer. The interview schedules were mainly deployed on the key informants and at focus discussions to solicit information about study area with respect climate variation and cultural mourns and values related gender. The contents of the questionnaire and interview schedules were guided by the specific objectives, research questions and hypotheses of the study. The content development took cognizance of the research questions and hypothesis guiding the direction of the study. The questionnaire was made up of sections, with each section designed



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to collect data that addressed specific objective, research question and hypothesis.

In order to avoid ambiguity, farmers were assisted to complete questionnaires by trained field officers as they explained to the exact implication of the questions within the context of the study. Eight (8) MoFA Agricultural Extension Officers stationed in the selected enumeration areas were selected and given training on the administration of the questionnaire so that the information collected would be as accurate as possible. The questionnaires and interview schedules ensured consistency in the questions asked by ensuring that all the candidates were asked the same questions making it easy to compare responses. The content of the questionnaire consisted largely of close-ended questions; this was done to avoid inappropriate responses to question. Official statistical procedure was used to obtain climatic data of the study area upon written request to the Ghana Meteorological Authority.

Transcribing was used during interview sessions with the permission of the participants. The contents of the recorders were used as data validation tools to ensure that respondents intended thoughts were not misrepresented by the field officers administering the instruments. The recorders served as audio backups specially to open ended responses provided by respondents.

## Data Collection Procedures

A combination of the descriptive and the methodological research approach were used for the study since it involved the description, evaluation of research questions and the testing of hypothesis to draw conclusions.



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A number of data collection techniques were used to obtain both the secondary and the primary data. With regard to the secondary data collection, document review and web-searching was used to obtain climatic, agriculture and demographic data of the Awutu-Senya District. Published books, Journals and news from the electronic media provided the literature about the study topic. Data on key climatic indicators (rainfall and temperature) from the Awutu-Senya District were obtained through official statistics collated by the Meteorological Agency.

Categorical and numerical data such as respondents' demographic and socio-economic data, family information, farming activities, economic and social background were collected using structured questionnaires from the 252 respondents. Data on respondents' perceptions about seasonal climate variations, effects of seasonal variations on cassava production, respondent's vulnerability and response strategies to adverse effects of seasonal variation on their livelihoods were obtained using a combination of structured and semi-structured questionnaires, interview schedules and focus group discussions. This required the preparation of a checklist of questions on specific issues surrounding the activity being studied.

It took four weeks to complete the designing of the questionnaire and another two weeks to pre-test it. Ample time was spent on the development and pre-testing of the questionnaire so that inconsistencies, ambiguities and other inadequacies that would have otherwise affected the overall quality of the survey results were eliminated. Questionnaires were administered by the selected MoFA officials, who were trained as data collection officers. Training



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of the field officers lasted for a period of three weeks after which they were given one week to rest. Questionnaire administration commenced on June 22, 2016 and lasted for two (2) months. The field officers were supervised by two supervisors who visited the enumerators every week, to ensure that enumerators were at post. Supervisors also assisted enumerators to resolve challenges pertaining to the data collection so as to ensure that the appropriate data were collected.

The semi-structured interview schedules were used to collect gender specific data about the issues being studied from the two key informants. During the interview sessions with the key informants, a checklist of questions was used to solicit information about seasonal climate variations, the effects of the seasonal variations on cassava production and how farmers' in the study area reacted to the effects of seasonal variations on their livelihoods. The information obtained from the key informants, strengthened the results obtained from the interviews conducted with the individual farmers. This method assumed that an individual's attitudes and beliefs did not form in a vacuum but were acquired through observations and interactions.

**Data Management**

All the 252 questionnaires were edited to identify the incomplete, inconsistent, or ambiguous responses before coding. Labelling and coding was done for both the quantitative and the qualitative data in order to identify and categorise similar responses. Labelling was done for open ended qualitative questions so that similar responses could be grouped under one numerical code.



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Coding facilitated data entry into the Statistical Softwares for Analysis. The IBM SPSS (formerly Scientific Package for Social Sciences –SPSS) version 21, and Microsoft Excel 2013 were used to process and analyse the data. Outputs from the softwares included totals, means, tables, diagrams, and proportions which were used to present the results.

Other important information of interest generated by the statistical softwares were gender disaggregated scores of responses on respondents' perceptions about climate variation, the effects of seasonal variations in rainfall and temperature on cassava production, adaptations strategies to the effects of seasonal variations and the factors that hampered the ability of a particular gender to adopt certain adaptations strategies.

To establish the link between climate variation and the subsequent effects on cassava production in the study communities (see Chapter 5), a time series analysis was conducted for rainfall and temperature data obtained from the Ghana Meteorological Agency spanning a period of 30 years starting from1984 to 2014. The time series analysis was done using Microsoft Excel (Version 2013). The results of the time series analysis were used to corroborate the results on the perceptions of farmers about rainfall and temperature trends in the study area. Inferences, predictions, conclusions and recommendations were made based on chi-square and symmetric test results obtained from SPSS analysis and on mathematical models on temperature and rainfall obtained from the time series analysis.

Table 8 provides a summary of the methodologies employed in the data collection and analysis.



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**Table 8: Summary of methods for achievement of specific objectives**

Main objective: Assess the gender dimensions in the adaptation to climate variation by farmers in the Awutu-Senya District.

| Specific Objective | | Data type | Variables involved | Measurement scales | Data source | Target population | Method (s) of data collection | Analytical method(s) |
|---|---|---|---|---|---|---|---|---|
| i. | Analyse the trends (decreasing, fluctuating or increasing) of climatic elements (temperature and rainfall) for Awutu Senya District over the past three decades | Quantitative | Rainfall and temperature and calendar years | Interval, ratio, ordinal | Secondary | Ghana Meteorological Authority | Documents and Records | Time series/trend analysis |
| ii. | explore the perceptions of male and female cassava farmers in the Awutu Senya District about climate variation and hypothesis one | Qualitative and quantitative | Perception, gender, climate variation | Nominal ordinal, interval and ratio | Primary | Cassava farmers in Awutu-Senya District | Structured and semi structured questionnaires | Frequencies, Percentage, $X^2$ test and symmetric measure |
| iii. | determine which gender is more vulnerable to climate variation impacts in the study area | Qualitative and quantitative | Perception, gender and vulnerability | Nominal ordinal, interval and ratio | Primary | Cassava farmers in Awutu-Senya District | Structured and semi structured questionnaires | Frequencies, Percentage, $X^2$ test and symmetric measure |



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**Table 8 Continued:**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| iv. | explore the effects of the variations (in climatic elements) on cassava production in the Awutu Senya West District from gender perspective over a 30-year period (1980-2014) and hypothesis two | Qualitative and quantitative | Effects of climate variation on farmers, gender and | Nominal ordinal, interval and ratio | Primary | Cassava farmers in Awutu-Senya District | Structured and semi structured questionnaires | Frequencies and Percentage, $X^2$ test and symmetric measure |
| v. | | | | | | | | |
| vi. | determine if the coping and adaptation strategies employed by males differ from those of female cassava farmers and hypothesis four | Qualitative and quantitative | Adaptation strategies used by farmers and gender | Nominal ordinal, interval and ratio | Primary | Cassava farmers in Awutu-Senya District | Structured and semi structured questionnaires | Frequencies, Percentage, $X^2$ test and symmetric measure |

Source: Author.



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**Ethical Issues**

The use of questionnaires and interview schedules to collect data required intimate interactions with the respondents. According to Silverman (2013), researchers should always remember that in the course of doing their work, they enter the privacy of participants. This raises several ethical issues that should be addressed during, and after the research has been conducted. Creswell (2003) states that the researcher has the obligation to respect the rights, needs, values and desires of the informants, hence the consent of the respondents must be sought for before involving them in a study.

The key ethical issues that were considered very important were the informed consent of respondents, voluntary participation of respondents, confidentiality and anonymity of those participating in the study, and harm and risk to the respondents as a result of participation in the study.

To address these ethical issues, measures that were taken did not compromise respondents and participants' rights. For instance, prior to the commencement of the fieldwork, participants were informed about the purpose and nature of the study, the data collection methods, and the scope of the research. Furthermore, the researcher explained to the respondents their role during the survey. Participants were selected and interviewed only after their consents were sought. It was also made clear to participants that the exercise was purely for academic purpose and that their participation was absolutely voluntary. The researcher assured the participants that their names would not be required neither would their identities be revealed.



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**Issues from the Field**

Time and financial limitations had a bearing on the sample size and the volume of data collected. The duration of the actual field work was two (2) months which did not permit the use of very large sample size considering the data collection procedure which involved interpreting questions for the understanding of individuals who did not understand the English language. The use of the semi-structured interviews schedules meant that respondents (selected cassava farmers) were given the opportunity to speak at length so that relevant information could be obtained. This made it very difficult to interview a large number of people. However, efforts were made to cover all issues relevant to the study. With a wide scope of analysis and the time constraints, the outcomes of this study cannot claim to be exhaustive. Changes (culture, and social norms) are taking place all the time, hence information and findings may inevitably, become out of date.

Community entry required getting permission from community authorities. It was a challenge to meet with the authorities and seek permission for the conduct of the survey. Once permission was obtained the next challenge was to get the trust of the people. There was a repeated effort to explain to the participants that the study was purely an academic exercise and nothing else. Some people thought that the study was meant for some type of intervention. They were constantly asking how this study was going to help them. After carefully explaining the reason for being there and the purpose of the research, they became cooperative.



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## Pretesting of Instrument

Before the actual fieldwork was dome, the instrument was tested at Bergro, a cassava farming community of the Fanteakwa District in the Eastern Region to ascertain its adequacy, efficacy, reliability and validity. The pre-test facilitated in the elimination of ambiguous and irrelevant questions. The pre-test also informed the decision of the sample size, the confidence interval and the estimated time required for the field work. It ensured that the target population was the one sampled. The entire exercise helped to strengthen the survey instrument and made it good enough to obtain the answers the questions demanded from the respondents, and to address the objectives, research questions and the hypothesis stated.

## Summary

This chapter has described the characteristics of the study area. It has also described the mixed method research design adopted and the justifications. The chapter outlined and described the sampling procedures used for the data collection and the description of the data collection instruments. It discussed the procedures for data the analysis and the data management tools: a combination of the sampling methods it was observed ensured a greater degree of accuracy. Ethical issues with regard to the confidentiality of the identity of the respondents as well as the challenges encountered in the field during the data collection have been addressed. Pretesting of the instrument ensured that it was good enough to answer the questions posed and address the objectives stated.



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# CHAPTER FOUR

# DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

## Introduction

Before addressing the core and specific objectives of this study, it is important to presents finding on the demographic characteristics of the respondents so as to give an outlook of the nature of the sampled population. Thus the chapter presents results on the characteristics of the respondents. These are socio-economic characteristics such as age, sex, educational background, marital status, religious affiliation and, social group affiliations. According to Mujere (2015), the impacts of climate variation, vulnerability and adaptation to the impacts depends on a number of factors including gender, age, socioeconomic status, caste and disability.

Table 9 presents the demographic data of the respondents. From Table 9 majority of the two hundred and fifty-two (252) cassava farmers were males. The ratio of female to male farmer was 1:1.3. In order to eliminate the effect of having more males than females in the sample taken (due to the preponderance of male farmers in the study area), within-gender or within-sex cross tabulation analysis was carried out for all the variables under observation. The within-sex cross-tabulation analysis allowed for comparison of the proportions of the female sample to that of the male's under evaluation.

## Age Distribution of Farmers

In terms of the age distribution (Table 9), most of the respondents (33%) were within the age bracket of 40-49. Results further show that the younger and the ageing population were not attracted to farming. This is evident on the fact



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that only 16% of all the respondents were within the age groups 20-29, and 60 years and above. Half of the 16% belonged to the 20-29 age group, while the remaining 8% belonged to the 60 years and above age group. The results further reveal that, the number of farmers in an age group increases as age increases, starting from the age group of 20-29 up to the 40-49 age groups which also happens to be the modal age group. After the modal age, the population then becomes inversely proportional to age and declines as age increases. The decline is gentle towards the 50-59 age group, but becomes very rapid after the 60 years and above age group.

**Gender and age Distribution of Farmers**

Looking at the age distribution from gender dimension (Table 9), it is clear that, the modal age group for both male and female respondents is 40-49. Further observations show that, there are more female farmers within the youthful age group than male farmers. After the modal age, more males than females, engage in cassava farming. The implication is that there are gender disproportions in terms of the ratios of male to female cassava farmers in the various age groups. Whereas more females were actively involved in cassava farming at the very youthful ages (20-29 age group), it was the males who remain committed to cassava farming as they advance in years (50 years and above).



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**Social Background of Respondents According to Gender**

The marital status results indicate that, almost 83% of the respondents were married, and of these 6.4% had polygamous marriage (Table 9). In terms of gender, there were more married male farmers than female farmers. Specifically, out of every 100 male respondents 88 were married. On the other hand, out of every 100 female respondents 76 were married. The rest were either single, divorced, windowed or separated.

Findings relating to the educational background of the respondents in Table 8, indicate that some 71% of the respondents have some form of formal education. With respect to the various forms of formal education acquired, 24% were educated to the basic (primary) level, 35% to the Junior High School (JHS) level or have had Middle School Leaving Certificate (MSLC), 7.9% to the Senior High School (SHS) or the Ordinary ("O") or the Advanced ("A") Levels and 3% to the Tertiary Level.

A comparison of the male and female educational attainment indicates that, there are more male farmers with formal education (Figure 7). Some 80% of the male respondents have formal education compared to 57.9% of the female respondents. In terms of the various forms of formal education, 21% of the males are educated to the basic level as compared with 30% of the females. On the other hand, more males (43%) than females (23%) are educated up to the JHS or the Middle School levels. With regard to the number of respondents having formal education up to the SHS or the "O" or the "A" Level, there are more males in this category than female (10% male compared to 5% females). Whereas 5.5% of the males have tertiary education, no female respondent was



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educated to this level. Thus based on the results it can be concluded that, there are more females at the lower levels of educational qualification than the males. But moving up the educational ladder, the number of females become lower and lower while the number of males increases (Figure 7).

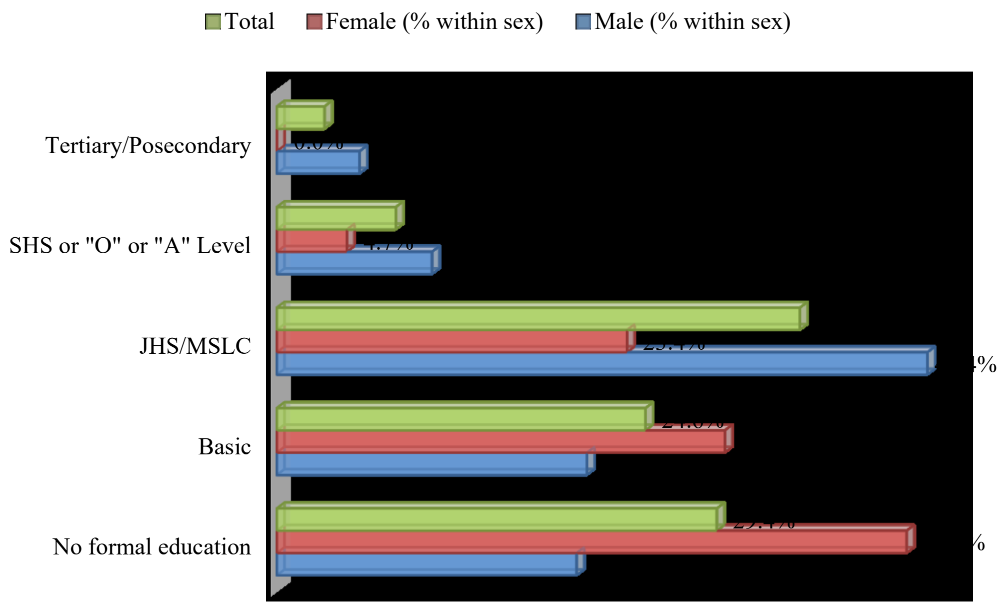


*Figure 7*: Gender representation of respondents' educational background
Source: Survey data (2016).

Data on the religious background of the respondents from Table 9 indicate that 3, 78% of all the farmers interviewed were Christians, and 18% were Muslims. The rest (6%) either belonged to the African Traditional Religion or were Atheists. Thus, Christianity was the religion with the largest followers. The religion with the second largest followers was Islam. From gender perspective, 83% of the female respondents were Christians, while 74% of males were also Christians. On the other hand, there were more Muslim among the male respondents than there were among the female respondents (Table 9).



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According to Table 8, the social group affiliation of the respondents indicated that, 62% either belonged to clubs, Farmer Based Organizations (FBOs), or peer groups. Majority (30%) belonged to FBOs; 21% were affiliated to peer groups, while 11% belonged to clubs. In terms of gender representation, there were more females (68%) belonging to social groups than males (58%). The majority of the independent farmers were males; that is, 32% male and 28% female independent farmers.



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**Table 9: Demographics of respondents**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Gender** | | Male | 145 | | | | | | | |
| | | Female | 107 | | | | | | | |
| | **Sex** | Total | 252 | | | | | | | |
| **Age group** | | | 20-29 | 30-39 | 40-49 | 50-59 | 60 and above | | | |
| | | %Male with gender | 7 | 21 | 33 | 29 | 10 | | | |
| | **Sex** | %Female with gender | 9 | 25 | 33 | 26 | 7 | | | |
| | | Total % | 8 | 23 | 33 | 28 | 8 | | | |
| **Marital Status** | | | N/R | Single | Married (Monogamy) | Married (Polygamy) | Divorced | Widow/Widower | Separated | Total |
| | | Male % within Sex | 1.0 | 6.2 | 80.6 | 7.6 | 2.8 | 1.4 | 0.7 | 100.0 |
| | **Sex** | Female % within Sex | 0.0 | 7.5 | 71.0 | 4.7 | 14.0 | 2.8 | 0.0 | 100.0 |
| **Educational Status** | | No formal education | No formal education | Basic | JHS/MSLC | SHS/O'l/A'L | Tertiary | | | |
| | | Male % within sex | 20 | 21 | 43 | 10 | 6 | | | |
| | **Sex** | Female % within sex | 42 | 30 | 23 | 5 | 0 | | | |
| | | Total % | 29 | 25 | 35 | 8 | 3 | | | |
| **Religious Background** | | | Christianity | Islam | Africa Traditional Religion | Atheist | | | | |



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**Table 9 continued**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Sex** | Male % within sex | 74 | 19 | 5 | 1 | 100 |
| | Female % within sex | 83 | 10 | 7 | 0 | 100 |
| | Total % | 78 | 15 | 6 | 1 | |
| **Social Group Affiliation** | | Club | FBO | Independent | Non-response | Peer Group |
| | Male % within sex | 9 | 32 | 40 | 2 | 17 |
| **Sex** | Female % within sex | 13 | 18 | 31 | 1 | 27 |
| | Total % | 1 | 30 | 36 | 2 | 11 |

Source: Field data (2016).
N/R = Non-Response



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## Summary

The chapter has presented the demographic and socio-economic characteristics of respondents based on selected variables such as gender, age of farmers, educational level, marital status and social group affiliations. These are presented to give an overview of the demographic structure of the population under investigation. The relevance of these demographic variables in the climate variation analysis will be demonstrated in the subsequent chapters in relation to the specific objectives.

Results showed that, males constituted the majority of the 252 cassava farmers. Most of the respondents were within the age brackets of 40-49. The younger and the ageing population were not attracted to farming. Again, more males had formal education than females. A gender-based analysis of respondents’ social background indicated that, there were more married male farmers than female farmers. A gender-based analysis of social group affiliation revealed that more females (68%) belonged to social groups than males (58%). On the other hand, the majority of the farmers who did not belong to any social group were males.



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# CHAPTER FIVE

# FARMER PERCEPTIONS ABOUT CLIMATE VARIATION AND GENDER-BASED VULNERABILITY

## Introduction

This chapter addresses specific objectives one, two and three of the study. In doing so, the chapter presents the findings on the perceptions of farmers about climate variation and the gender dimensions involved. The findings also include the gender dimensions of farmers' vulnerability and the more vulnerable gender to the adverse effects of climate variation.

Since the study deals with adaptations to climate variation from a gender perspective, it is important to establish the manifestation of climate variation in the study areas over the past years. It is also significant to have an idea about how long a farmer has stayed and farmed in the community so to link his/her climate variation experience over time to the years of faming in the community. Hence the chapter first describes the characteristic of key climatic elements (rainfall and temperature). This is followed by the results of farming experiences of respondents in relation to the length of farming in the community.

In line with objective one, the chapter presents the findings of the gender dimensions of perceptions of cassava farmers about climate variation. It also presents the findings of the vulnerability of cassava farmers to the variation in climatic elements from the gender view point and subsequently the more vulnerable gender in accordance with objective two and three. The findings emanating from the results of the study are evaluated against previous findings



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from related studies. The implications of the finding on farmers, and on cassava production as a whole are explored.

In presenting the findings:

- The perception of respondents about climate variation are evaluated against variables such as age of respondents and farming experience in order to determine how these variables affect their perception.
- The relationship between perception and formal education is examined.
- The link between vulnerability to climate variation and variables such as access of land, education, information, social group affiliation, religion and support from spouse together with the gender-based factors influencing the vulnerabilities to the variations in the climatic elements are explored.
- Perceptions of cassava farmers about the more vulnerable gender to climate variations are also evaluated.
- The statistical hypotheses test result supporting or dismissing the assertion that there are no gender difference in vulnerability to climate variation by cassava farmers are presented alongside the results.

**Rainfall and Temperature distribution of Awutu Senya District**

Rainfall and temperature are the key climatic elements that affect crop production. Consequently, variations in these climatic elements adversely impacts crop production and imposes a major constraint on farming planning,



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mostly under rainfed conditions. Considering the recent advances in climate science, many studies are trying to provide a reliable basis for climate, and subsequently agricultural production forecasts (Mohammad, 2016). In this regard the rainfall and temperature data of the study area was collected and analysed. This is in line with the specific objectives that sought to explore the gender perceptions of and effects of climate variation on cassava production in the study area.

**Rainfall over Awutu Senya West District**

The annual rainfall distribution for the period 1984-2014 at Agona Sewdru, Kwayanko, and Pomadze are presented in Tables, 10, 11 and 12. The seasonal rainfall departures from the mean rainfall for three decades (1984-2014) are presented in Figures 8, 9 and 10. A linear trend is added to indicate the direction of rainfall over time. Positive variations from the mean are considered as increase in rainfall while negative variations or departure are considered as decreases in rainfall.

**Table 10: Rainfall data at Swedru**

| Year | Mean Annual Rainfall (in mm) | Percentage departure from Mean |
|---|---|---|
| 1984 | 1245.0 | 0.66% |
| 1985 | 1161.9 | -6.1% |
| 1986 | 968.1 | -21.7% |
| 1987 | 1124.9 | -9.1% |
| 1988 | 1067.2 | -13.7% |
| 1989 | 1123.4 | -9.2% |
| 1990 | 919.5 | -25.7% |
| 1991 | 1544.1 | 24.8% |
| 1992 | 910.1 | -26.4% |
| 1993 | 1077.0 | -12.9% |



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**Table 10 continued**

| | | |
|---|---|---|
| 1994 | 1109.6 | -10.3% |
| 2001 | 1143.5 | -7.5% |
| 2002 | 1318.0 | 6.6% |
| 2003 | 1182.4 | -4.4% |
| 2004 | 1029.7 | -16.7% |
| 2005 | 1113.3 | -10.0% |
| 2006 | 1510.8 | 22.1% |
| 2007 | 1493.1 | 20.7% |
| 2008 | 1529.4 | 23.6% |
| 2009 | 1213.0 | -1.9% |
| 2010 | 1861.9 | 50.5% |
| 2011 | 1153.3 | -6.8% |
| 2012 | 1415.7 | 14.5% |
| 2013 | 908.6 | -26.5% |
| 2014 | 1806.5 | 46.1% |
| Total | 30930.0 | |
| Mean Rainfall over the 3 decades | 1236.876 | 0.00 |

Source: Ghana Meteorological Authority (2015)

Considering the rainfall distribution pattern of Agona Swedru, rainfall varied throughout the 30-year period (Figure 8). Rainfall was below average between 1984 and 1990. It was above average in 1991, but fell below average in 1992 to 2001. Rainfall was above average in 2002 to fall below average again between 2003 and 2005. Between 2006 and 2008 it was above average while, 2009 recorded a value below average. From 2008 to 2014 annual rainfall totals varied above and below the average every other year. Much of the 30-year period recorded rainfall below the average.



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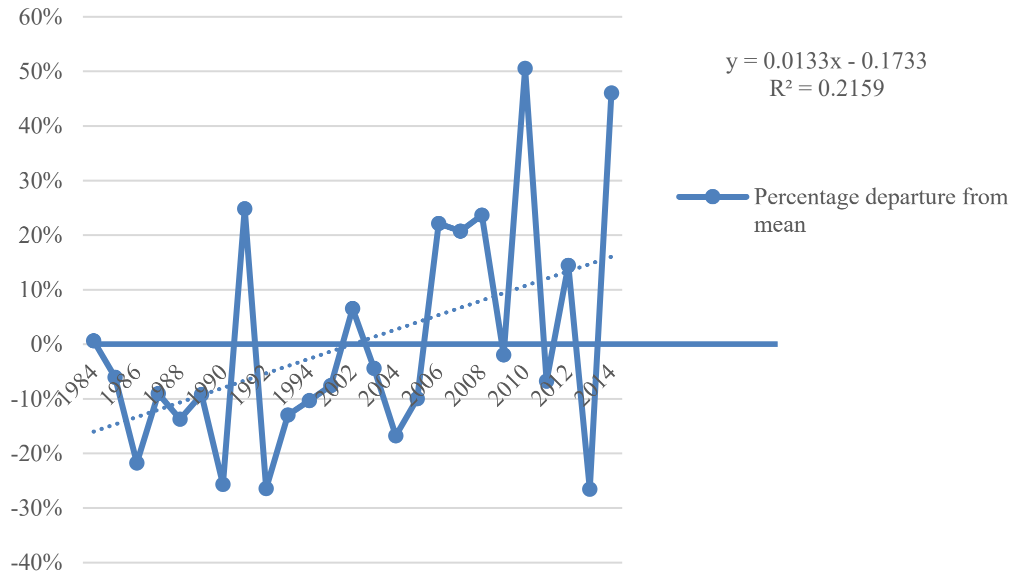


*Figure 8*: Deviation of annual total rainfall from the mean at Swedru, (1984-2014)

Source: Ghana Meteorological Agency (2015)

Similar observations were found in the rainfall patterns for Kwanyako and Pomadze as shown in Figures 9 and 10. According to Figure 9 and Table 11, rainfall below the average was recorded between 1984 and 1996 at Kwanyako. It was above average in 1997 to fall in 1998. A similar trend is observed from 1999 to 2003. From 2006 to 2008 the annual total rainfall was above average, but was below average in 2009 to rise above average again in 2010 and 2011. Between 1984 and 2002 there were more rainfall totals below the average, while between 2003 and 2014 more annual totals were above the average.



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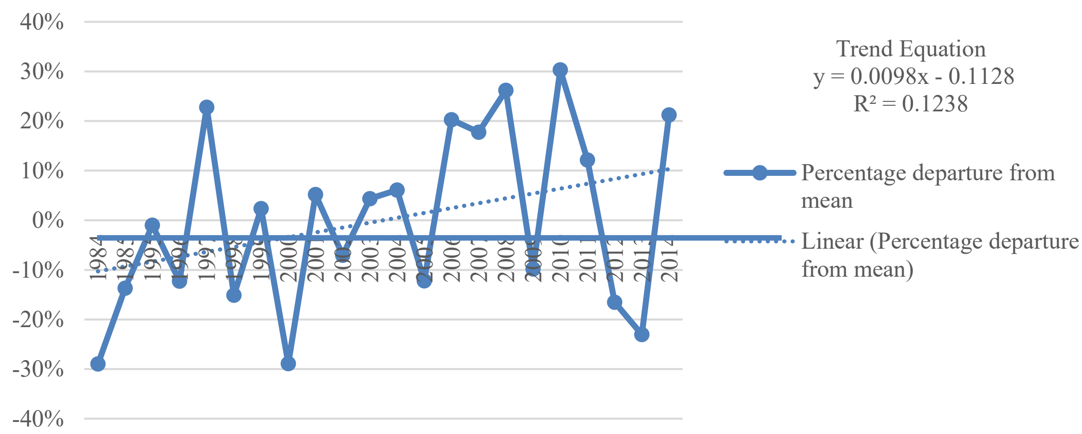


*Figure 9*: Deviation of annual total rainfall from the mean at Kwanyako, (1984- 2014)

Source: Ghana Meteorological Agency (2015).

**Table 11: Rainfall data at Kwanyako**

| Year | Average Yearly Rainfall | Percentage departure from Mean |
|---|---|---|
| 1984 | 875.6 | -28.99% |
| 1985 | 1064.4 | -13.67% |
| 1995 | 1221.0 | -0.97% |
| 1996 | 1081.6 | -12.28% |
| 1997 | 1513.6 | 22.76% |
| 1998 | 1046.8 | -15.10% |
| 1999 | 1261.6 | 2.32% |
| 2000 | 876.9 | -28.88% |
| 2001 | 1296.7 | 5.17% |
| 2002 | 1146.0 | -7.05% |
| 2003 | 1286.8 | 4.37% |
| 2004 | 1307.8 | 6.07% |
| 2005 | 1082.3 | -12.22% |
| 2006 | 1482.5 | 20.24% |
| 2007 | 1451.8 | 17.75% |
| 2008 | 1556.1 | 26.21% |
| 2009 | 1111.9 | -9.82% |
| 2010 | 1607.0 | 30.34% |
| 2011 | 1382.4 | 12.12% |
| 2012 | 1029.0 | -16.54% |
| 2013 | 948.6 | -23.06% |
| 2014 | 1494.7 | 21.23% |
| Mean | 1232.958 | 0.00 |

Source: GMet (2015)

With regard to Figure 10 and Table 12, which represent the rainfall



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distribution pattern at Pomadze, just as in the case of Swedru, more annual totals were below the annual mean.

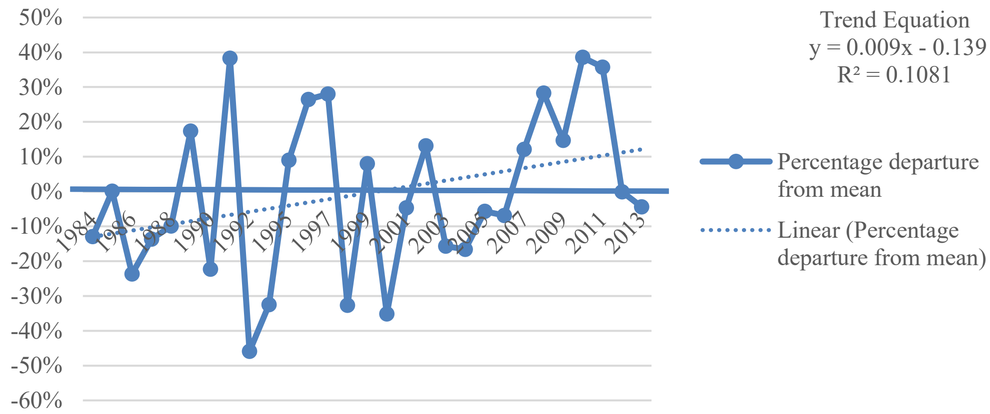


*Figure 10:* Deviation of annual total rainfall from the mean at Pomadze, (1984-2013)

Source: Ghana Meteorological Agency (2015).

**Table 12: Rainfall data at Pomadze**

| Year | Average Yearly Rainfall | Percentage departure from Mean |
|---|---|---|
| 1984 | 731.5 | -13% |
| 1985 | 840.9 | 0% |
| 1986 | 641.1 | -24% |
| 1987 | 724.7 | -14% |
| 1988 | 756.4 | -10% |
| 1989 | 985.5 | 17% |
| 1990 | 652.6 | -22% |
| 1991 | 1161.8 | 38% |
| 1992 | 454.5 | -46% |
| 1993 | 567.1 | -32% |
| 1995 | 915.2 | 9% |
| 1996 | 1062.2 | 26% |
| 1997 | 1075.3 | 28% |
| 1998 | 565.1 | -33% |
| 1999 | 906.6 | 8% |
| 2000 | 544.3 | -35% |
| 2001 | 800.5 | -5% |
| 2002 | 950.1 | 13% |
| 2003 | 708.4 | -16% |



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**Table 12 continued**

| | | |
|---|---|---|
| 2004 | 700.5 | -17% |
| 2005 | 791.7 | -6% |
| 2006 | 782.1 | -7% |
| 2007 | 941.7 | 12% |
| 2008 | 1077.5 | 28% |
| 2009 | 962.9 | 15% |
| 2010 | 1163.4 | 39% |
| 2011 | 1140.2 | 36% |
| 2012 | 839.0 | 0% |
| 2013 | 802.9 | -4% |
| Annual Average | 839.8 | |

Source: GMet (2015)

On the whole, the three stations recorded more annual totals below the average. Variations of annual totals from the mean have been recurrent over the 30 years at the three (3) station.

### Temperature Pattern of the Awutu Senya District

Figure 11 shows the annual mean of the maximum and minimum temperatures of Agona Swedru between 1984 and 2014. A close observation shows an increasing trend and by the positive gradient (0.0135) of the trend equation y = 0.0135x + 27.2, where y is the temperature over a time period and x is the time period.

According to the trend equation, on the average, the temperature of the area increased by 0.135°C every decade over the 30 years and by 2024 the temperature of the area is projected to increase by 0.54°C.



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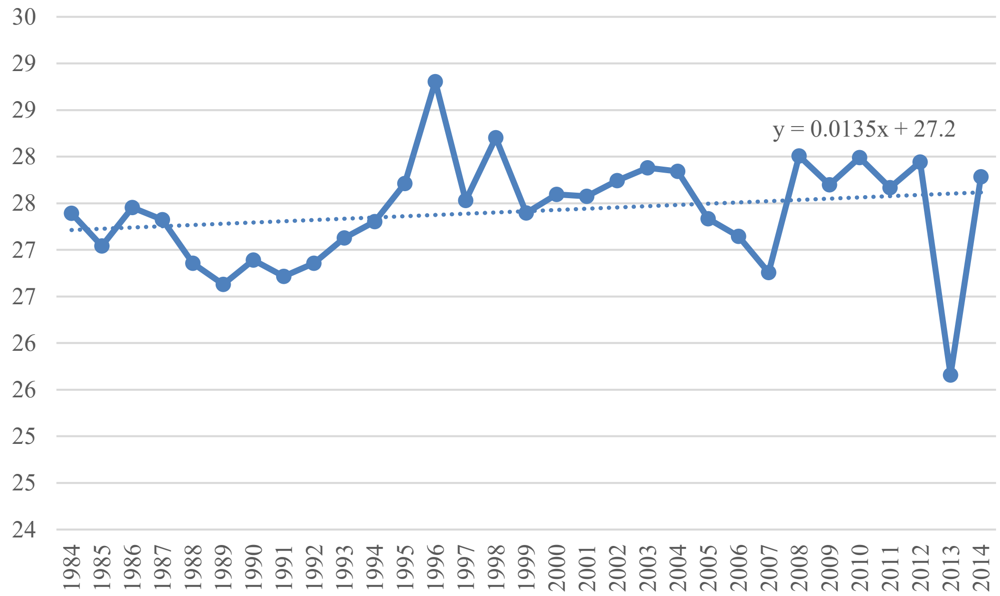


*Figure 11*: Mean annual temperature distribution at Agona Swedru, (1984-2014).

Source: Ghana Meteorological Agency (2015)

Figure 12 represents the mean annual minimum and maximum temperature conditions at Kwanyako. The temperature distribution of Kwanyako exhibits an increasing trend. The mean annual temperature of Kwanyako increased by an average of 0.169ºC every decade, and by 2024, the mean annual temperature is projected to increase by 0.68ºC. But unlike that of Agona Swedru, the rate of increase in the mean annual temperature at Kwanyoko is slow.



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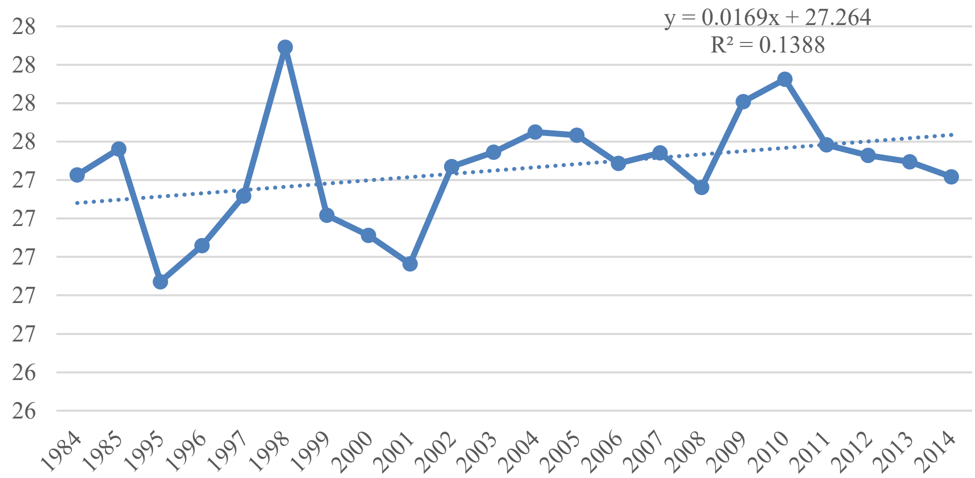


*Figure 12:* Mean annual temperature distribution at Kwanyako, (1984-2014)
Source: Ghana Meteorological Agency (2015)

The time series analysis of both rainfall and temperature data of the study area show climatic variations. Rainfall was irregular and decreasing over the years while the mean temperatures were increasing (Acheampong, 2009; Savitsky, 2017). The results confirms the IPCC (2007a) report and the findings of Chakeredza, et al. (2009) which indicate that global temperatures are rising while rainfall pattern is becoming very unpredictable. Sagoe (2006) has also observed that there was a positive correlation between cassava yields and the mean annual rainfall and temperature patterns. These findings suggest that the cassava farmers in the study area will impacted by the variations on these climatic elements.

**Farming Experiences of Respondents from a Gender Perspective**

Previous studies have shown that farmers' perceptions are determined by factors such as education, farming experience, gender and access to extension services (Deressa et al., 2009; Gbetibouo, 2009; Nhemachena & Hassan, 2007).



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To find out farmers' experiences about climate variation, the respondents were asked to indicate how long they had been farming and how often their climate varied in the communities they lived. The results (Figure 13) indicate that 75 respondents (30%) had farmed within the study area for some 6 to 10 years. Another 55% had been farming for over 10 years. Six (6) to ten (10) years farming experience in the study area was considered significant enough for a farmer to experience climate variation. The results show that 30% of the 147 male respondents and 30% of the 107 female respondents had been farming in their communities for 6 to 10 years. The results also reveal that 87% of the male and 72% of the female respondents had been farming in their communities for more than 5 years (Figure 13).

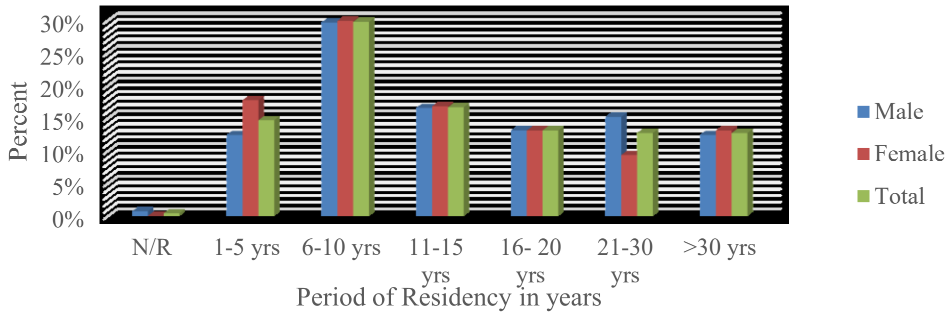


*Figure 13*: Respondents length of farming

Source: Field data (2016).

**Farmers Perceptions on Climate Variation**

Specific objective one of the study was to find out the perceptions of men and women farmers on the seasonal variations in the climatic elements. To achieve this objective, a series of questions were posed. Farmers were first asked to state the yield trend of key crops such as cassava, yam, vegetables and maize they had been cultivating. They were supposed to indicate whether yields were increasing, stable, fluctuating or decreasing as a result of the variation in



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the climatic elements. The results indicate variation over the years as shown in Figure 14.

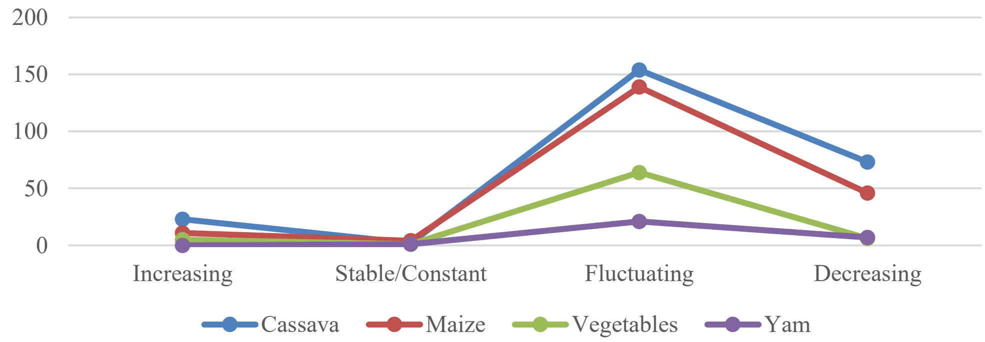


*Figure 14*: Yield trends of cassava, maize, vegetables and yam in the Awutu-Senya district

Source: Survey data (2016).

Respondents were asked to indicate if they noticed any change in the weather pattern during the thirty-year period. If changes were noticed, respondents were to indicate the interval and type of change. Approximately 98% of the respondents acknowledged noticing some changes in the weather pattern. Of these 57% were males and 43% were females (Figure 15).

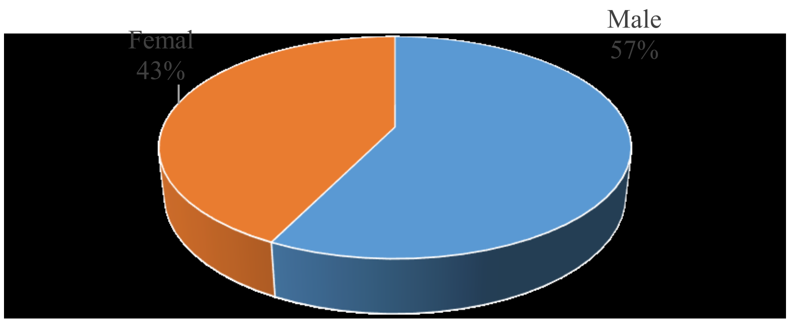


*Figure 15:* Gender representation of respondents who indicated they had noticed changes in weather pattern during the past thirty years.

Source: Survey data (2016).



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With regard to the frequency of change, 131 (52%) respondents said they noticed some changes in the weather pattern every other year. This comprise of 56% of the males and 47% of the females (Figure 16).

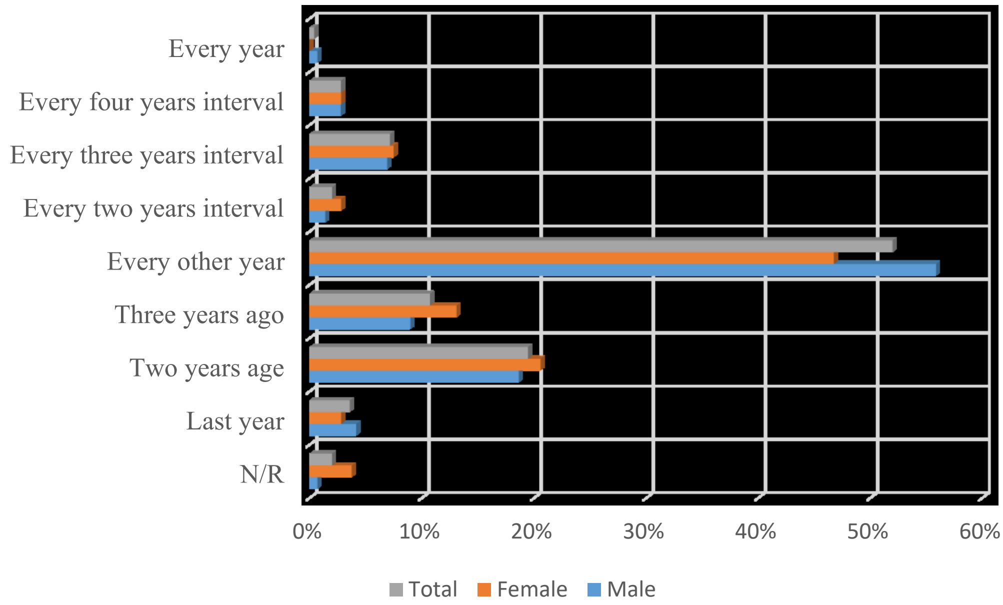


*Figure 16:* Frequency of changes noticed

Source: Survey data (2016).

Some of the changes noticed included decreasing amount of rainfall, rains not occurring at the expected time, reduced rainfall periods, longer dry seasons, and high temperatures. Other observations were increasing severe droughts, increasing floods and low temperatures.

Eighty-five percent (85%) of the respondents said rainfall was decreasing during the thirty-year period. Seventy-five percent (75%) said the rains did not come at the expected time, while 58% said reduced rainy periods were the noticeable changes. Some, 8% however, said they had noticed some increasing amounts of rainfall during the thirty-year duration (Figure 17).

In terms of gender disaggregation, 63% of the males said they had noticed reduced rainy seasons while 51% of the females also said rainy seasons



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had reduced. Seventy-seven percent (77%) males compared with 73% females said the rains do not fall at the expected times. Some 29% males and 17% females noticed increasing drought periods while 52% males and 50% females said they noticed rising temperatures. For those who noticed reduced dry seasons, 5% were males and 8% were females. (Figure 17).

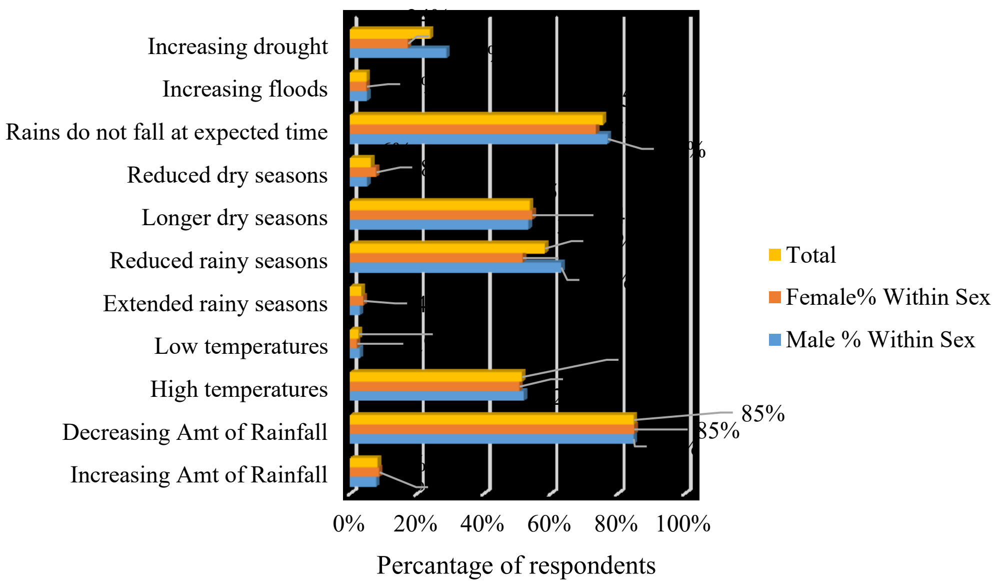


*Figure 17*: Farmers observation of the weather

Source: Survey data (2016)

Analysis of respondents perceptions of how climate variation was affecting seasonal rainfall weather patterns according to age group (Table 13) reveal that, majority of those who were of the opinion that the rains were decreasing as the seasons went by were the older farmers (40 years and above). They were also the majority who said that rainfall was erratic and temperatures were increasing. These perceptions were consistent with the climatic data of the study area.



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**Table 13: Farmer perceptions of the effects of climate variation on rainfall and weather patterns by age**

| Observed Changes | Age Group 20-29 | 30-39 | 40-49 | 50-59 | 60 and above |
|---|---|---|---|---|---|
| Decreasing Amount of Rainfall | 70% | 72% | 94% | 85% | 95% |
| High temperatures | 50% | 45% | 59% | 44% | 65% |
| Reduced dry seasons | 5% | 5% | 6% | 7% | 5% |
| Rains do not fall at expected time or erratic rainfall pattern | 40% | 66% | 83% | 81% | 90% |
| Increasing floods | 5% | 5% | 6% | 3% | 5% |
| Increasing drought | 15% | 28% | 29% | 19% | 20% |

Source: Survey data (2016)

Multiple Responses

Respondents said the observed changes in the weather pattern were caused by the following: environmental degradation, climate, natural phenomenon and punishment by God. Seventy two percent (72%) attributed the causes of variations in climate to environmental degradation, while 15% linked the changes to natural phenomenon. A few (1%), linked the changes to God's punishment to mankind (Figure 18).



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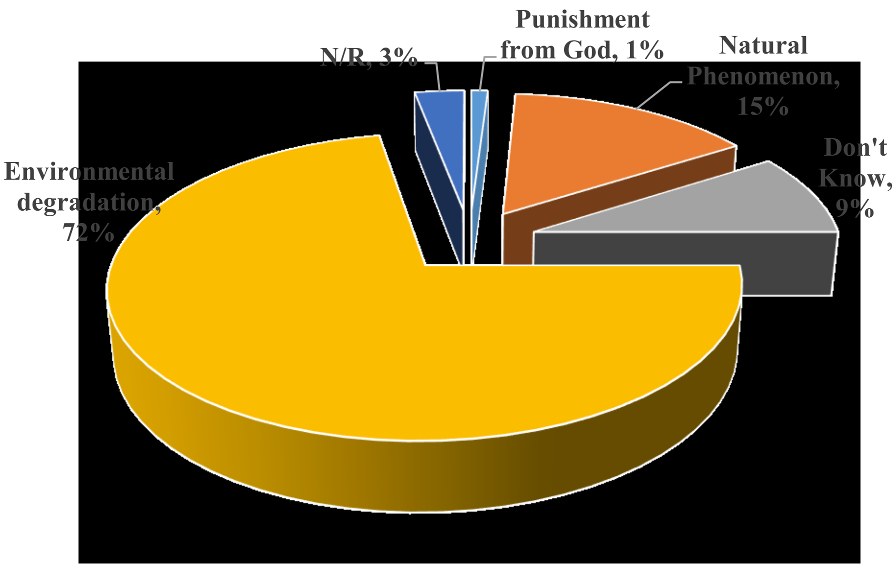


*Figure 18:* Possible causes of seasonal variations

Source: Survey data (2016).

N/R = Non-Response

There were difference in opinions between male and female respondents with regard to the possible causes of the seasonal variations (Figures 19). For example, 67% of those who linked causes of the variations in the climatic elements to environmental degradation were males. On the other hand, majority of those who said that the causes were the result of natural phenomenon or punishment by God were females. More males than females had no idea about the causes of seasonal variations.



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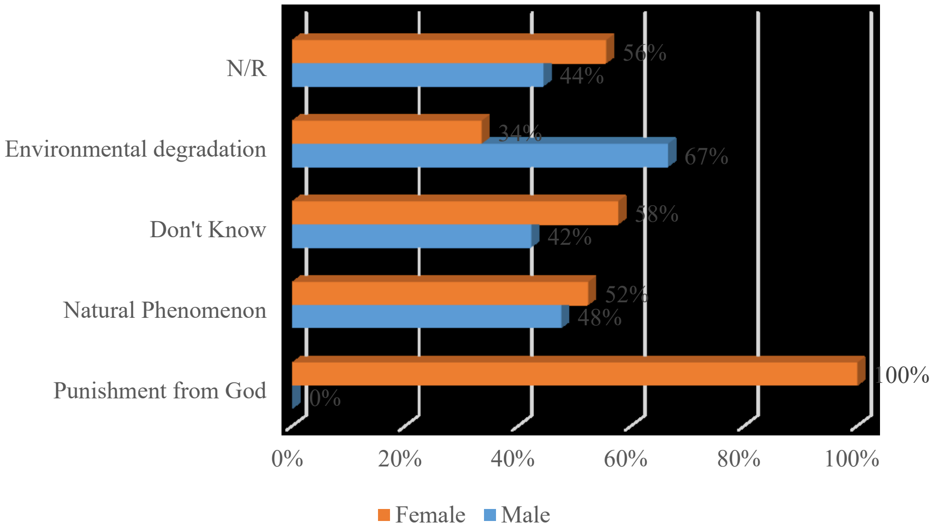


*Figure 19*: Gendered perception about the possible causes of seasonal variations

Source: Survey data (2016).

N/R = Non-Response

To find out if respondents' actually noticed changes in the weather pattern, they were asked to indicate the onset of the rainy and the dry seasons every year over the past three decades. The results were then cross checked with the climatic data of the study area obtained from the Ghana Meteorological Agency (GMet). The results indicate mixed responses as shown in Table 14. The majority (66%) indicated that the rainy season usually starts from March every year, while 15.5% indicated February as the start of the rainy season. On the other hand, 14.6% said it is in April and 2.4% said it starts from May. Of those who said the rainy season starts from March, 69% were males and 31% were female, while 67% of those who indicated the month of May as the beginning of the raining season were females and 33% were males. With regard to the onset of the dry season, the majority (53.4%) said the dry season starts from December, with 61% of them being males and 39% being females; 42.1%



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respondents indicated the month of November. Approximately 2% (each) named the months of January and October. Of those who said the month of January marked the onset of the dry season, 60% of them were females while 40% were males.

Comparing the responses with the data from the GMet, the majority, mostly the male responses exactly matched with those of the GMet's data. According to the GMet's data the rainy season usually starts from March and ends in November (see Appendix A).

**Table 14: Respondents' opinions about the onset of the rainy and the dry seasons**

| | | Beginning of the raining season | | | | | |
|---|---|---|---|---|---|---|---|
| | | April | February | March | May | N/R | Total |
| | Male | 17 | 27 | 98 | 2 | 1 | 145 |
| Sex | Female | 20 | 12 | 69 | 4 | 2 | 107 |
| Total | | 37 | 39 | 167 | 6 | 3 | 252 |
| Sex | Male | 81 | 2 | 2 | 57 | 3 | 145 |
| Sex | Female | 51 | 3 | 2 | 49 | 2 | 107 |
| Total | | 132 | 5 | 4 | 106 | 5 | 252 |

Source: Survey data (2016).

The above results showed that almost all the respondents interviewed had noticed changes in the rainfall and temperature patterns during the past thirty years. Almost all the farmers knew that some changes in the temperature and rainfall pattern had taken place, which eventually affected yield trends of key crops. Farmers identified decreasing rainfall, increasing drought, erratic rainfall pattern and increasing temperatures as the most frequent occurrences.



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These observations were consistent with the results obtained from the analysis of the climatic data. The observations are also corroborated by the findings of the Ghana's Second Communication Report to the UNFCCC, (2011) and McSweeney et al, (2010) which indicate that, Ghana is already experiencing a monthly rainfall decrease of about 2.4 percent per decade and an increase in the mean annual temperature of 1°C per decade since 1960, (Government of Ghana, 2011; McSweeney et al, 2010). It was also noticed that factors such as age of respondent, period of stay in the study area, educational level of respondent and social group affiliation play significant roles in the formation of respondents' perceptions.

The majority of respondents who perceived decreasing trend in the rainfall, increasing trend in temperatures, reduced rainfall period, and erratic rainfall patterns as emerging climatic trends of the study area were in the age group of 40 years and above. For example a fifty year old farmer who had stayed and farmed in the study area for over ten years said:

> "P*reviously, the rainy periods within the major season exceeded four months of regular and intense rains spanning from June to September while relatively sparse rains between April and May in very low amounts were observed. But now the rains are intermittent within the major season with reduced amounts of rainfall, at the same time the dry periods are becoming longer and even far between in the major season. This makes it very difficult to predict the weather."*

According to the findings, a greater proportion of the older respondents have been farming in the area for at least 10 years; 63% who had stayed in the



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study area for more than 10 years were above 40 years. The implication therefore is that, the older farmers have lived and farmed in the study area long enough to have observed some climate variations in the study area. Similar findings have been reported by Mamba (2016) whose findings indicate that, the age of farmers helped them to perceive more accurately compared to younger farmers due to their many years of farming experience and to the indigenous knowledge that help them perceive correctly climate variables such as rainfall in the beginning of each farming season.

Social group affiliation shaped the farmers' perceptions of climate variation in the study area as indicated by Oremo (2013) and cited in Rashida Ayumah (2015). Discussions with respondents revealed that several farmers came together to form some kind of association with the aim of working as groups. These groups usually shared information about improved farming practices, the weather and the right planting times in view of the changing weather conditions. The groups were given support in the area of climate smart agricultural practices to stand the challenges posed by climate variation by Community-based Organization (CBOs), Agricultural Extension Officers, and some government agencies (MoFA). The findings corroborate the findings of the study conducted by Gbetibouo (2009) which states that farmers with access to extension services are more likely to perceive changes in the climate because extension services provide information about climate and weather. Hence information sharing among group-members helped to shape the individual cassava farmers' perceptions or opinions about climate variation. This finding is also supported by that of Tazeze, Haji, and Ketema, (2012) in eastern Ethiopia that said that access to information on climate change through farmer to farmer



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extension was a significant factor that explains farmer's perception of climate change.

The gender dimensions of the results on perceptions indicated that, gender is a significant social factor within the study area. It influences the perception of individuals about climate variation. This has been corroborated by the findings of Tazeze, et al. (2012), which indicate that, the sex of a household head is a significant determinant in perception of climate change and variation. Results of the present study have shown that, it was through the male dominated perception that erratic rainfall, long drought periods, increasing temperatures and decreasing rainfall pattern were found to be associated with climate variation. These perceptions were more consistent with the results of the climatic and data of the study area. Majority of the males (67%) associated seasonal variations with environmental degradation. On the other hand, females were in the majority of those who perceived that rainfall amounts were increasing, and the dry season periods were also decreasing. The latter perception was not in conformity with the empirical data of the study area. A few of the female respondents were of the view that the current climate variation is the punishment from God, or a natural phenomenon, which no one can stop. This conclusion drawn by the majority of the female could be as a result of their religious belief coupled with the lack of formal education. For example, three female respondents from, Bawjiase, Awutu-Breku and Bontrase respectively gave the following responses when asked their perceptions about the causes of climate variation and why.

*1.* Christian basic school leaver respondent from Bawjiase: - *Everything that has happened or yet to happen to the weather or climate has been*



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*established by God since the beginning of creation and was bound to happen no matter what anybody did or does.*

2. Muslim basic school leaver respondent from Awutu-Breku: - *We Muslims believe that Almighty God usually allow certain thing like drought and floods to occur as ways of punishment for our sins.*
3. Illiterate African Traditional believer from Bontrase: - *When an abomination is done and the land is not pacified, then the gods send down curses in the form of drought and thunderstorms as punishment.*

Hope and Jone. (2014) indicate that both Christians' and Muslims had relatively low perceptions of urgency for environmental issues, particularly climate variation, due to beliefs in an afterlife and divine intervention.

According to Mohammad (2016); Boru, and Koske (2014), valid perceptions are important for developing, or adopting successful adaptation strategies.  As this perception of risk is essential for motivating farmers in their decision to adapt. That was why the majority of the males were more likely to take steps that would mitigate the effects of any climatic variations on their livelihood. They were more prepared to accept adaptation measures or improved practices that would help alleviate the effects of the variations in the climate on their livelihood. Those who had the perception that the causes of climate variation were an act of God, and hence nothing could be done about it, would most likely not try to find any solution for combating the adverse effects of climate variation on their livelihood. They would rather accept the extreme climatic event as coming from God. Furthermore, those who were not even aware of the possible causes of climate variation, the majority of who were females, are also likely to be overtaken by events. Being aware of the possible



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causes of a phenomenon helps to take the appropriate actions that will remedy the situation (Mohammad, 2016; Boru, & Koske, 2014).

A major reason why more of females had wrong perceptions about climate variation and its causes could be explained by the fact that there were more illiterate female farmers than the males as demonstrated in the gender analysis of respondents' educational background in chapter four. Even in situations where some of the female respondents had had formal education, most of them stopped at the basic level. These findings are in consonance with the findings from the study by Rakgase and Norris (2015), where education, literacy level, and gender were important predictors of how farmers perceive climate change and drought phenomena.

Gender diversity in perceptions about occurrence of climate variation and causes could also be based on cognitive and normative difference in the capacity to recognize the risks posed by climate variation. Again differences in the perceptions of male and female farmers could have taken root from social or cultural norms of the study area. For example during an interview session with the male opinion leader from Awutu-Breku, he said that*:*

> *"Parents usually prefer to use their limited financial resources in educating the boy/male within a family than the girl/female to the highest level because it is their belief that the males are usually brighter and it is they who will eventually become heads of families with greater responsibilities.* He further indicated that: *"as for females, they will one day marry and become a man's responsibility."*

This type of response was consistent with majority of the respondents and also reflective in the educational background of the respondents as indicated



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in chapter four. The observations agree with those by Grothmann and Patt, (2005); Maddison, (2007); Hamilton and Kasser (2009) and Ostrom (1990).

**Gender Dimensions of Factors Influencing Vulnerability**

The second specific objective of the study was exploring the gender dimensions of the factors influencing vulnerability to the adverse effects of climate variation among cassava farmers in the study. The IPCC (2007b) and Adger (2006) have indicated that the vulnerability of a population to climate variation depends on three factors: first, the degree of exposure to climate change phenomena; second, the population's sensitivity to the phenomena; and third, the population's capacities to adapt to the changes. According to the IPCC (2007b) and Adger (2006), the last two factors are determined by economic and social conditions of the population. Generally, poverty and marginalisation are associated with high level of vulnerability to climate change or variation impacts. Evidence from earlier studies have shown that certain groups are expected to be more vulnerable to climate variation partly due to their limited access to information, level of education, and financial resources (Dzah, 2011; et al., 2008; Dankelman, 2010). Gender-based differences in rights, time use, and access to assets, resources and credit, and to socio-cultural norms also increase one gender's vulnerability to the effects of climate variation (Habtezion, 2012). Based on these earlier findings, the present thesis sought to identify the more vulnerable gender to climate variation among cassava farmers in the study area by analysing the gender dimensions of the factors influencing vulnerability of the farmers to climate variation such as education, access to weather information, support services and land resources. Assessment of the



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farmers' vulnerability status was also done using the effects of climate variation on their standard of living.

***Education and vulnerability to climate variation***

The ability to cope with the adverse effects of climate variation depends on one's level of understanding of the situation and the utilisation of the knowledge available for handling such a situation (Zulu, 2016; Antwi-Agyei, 2012). In this regard, the educational background of the respondents was necessary. Results show that, 54% of the respondents were either illiterate or had very minimal formal education. Some 72% of the female and 41% of the male respondents were without formal education, or have had formal education only to the basic level (see Figure 7).

The findings thus suggest that the educational background of the female respondents is largely illiterates or have limited formal education. Majority of the respondents with little or no formal education were females (73%). This is in consonance with the revelations by the opinion leader from Awutu-Breku which sought to suggest that there is a preference for boy child education over the girl child in the study community due to certain cultural beliefs. Another finding from the study results that supports this assertion was that from an interview session of a women respondent from Senya-Breku. According to her:

> *they were seven children in their family, two males and five females and out of the seven only one of the females was educated up the SHS level however, all the two males had formal education up to the tertiary level and are all now working in formal institutions.* The explanation given by their parents was



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that; *their brothers will take care of them (the female siblings) and their children in future including them (the parents themselves).*

The implication of the low level of education of the majority of females is that they were more likely to be at risks to the consequences of unstable weather condition than their well-educated male counterpart. On the other hand, since the majority of the males' have better educational background, variations in the climate would not affect them as much as the females. Empirical findings by Dzah (2011) have confirmed education as an important means or resource that determines the vulnerability of an individual or group to climate variation. According to the author, farmers with higher education qualifications understand better the changes that occur in the weather elements, and hence are able to take measures to avoid the adverse effects. Antwi-Agyei (2012) has observed that, communities that succumb to the greatest vulnerability to drought are defined by low educational levels.

***Gender, and access to sources of weather information***

Another vulnerability factor that was evaluated with respect to gender was respondents' ability to access reliable weather information. Challinor, Slingo, Wheeler, Craufurd and Grimes, (2003) have stated that, access to climate information and forecast help farmers to make strategic decisions concerning their farm operations, as such respondents were asked to indicate their sources of weather information. Various sources were reported (Table 15). In terms of specific sources of weather information, the most common source was radio. Some 81% obtained their weather information from radio broadcast.



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Majority of those who obtained weather information from radio broadcast were males.

**Table 15: Respondents sources of weather information**

| Sources of Weather Information | Male | Female | Total average |
|---|---|---|---|
| Personal Observation | 68% | 64% | 66% |
| From Group Members | 4% | 4% | 4% |
| Radio | 86% | 76% | 81% |
| Television | 50% | 48% | 49% |
| Neigbours | 5% | 10% | 7% |
| Family Members | 4% | 10% | 7% |
| Traditional Knowledge | 39% | 47% | 42% |
| Through AEAs | 15% | 25% | 19% |
| Do not pay attention to weather prediction | 0% | 1% | 0% |
| Church Members | 0% | 1% | 0% |

Source: Survey Data (2016)

Within Gender Analysis

Specifically, 86% males and 76% female respondents mentioned radio as the main source of weather information. Personal observation was the next most common source of weather information reported by the respondents; 68% males and 64% of the female respondents obtained their weather information from this source.

Other sources of weather information frequently sought for by farmers included television and traditional knowledge. Whereas the majority of females relied on agricultural extension and traditional knowledge for weather information, more males obtained information from television (Figure 20).



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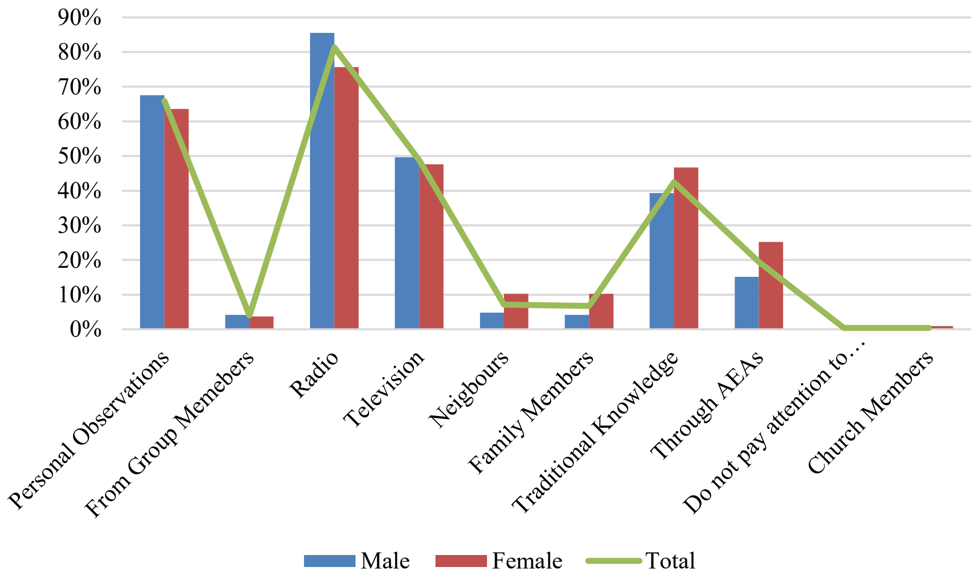


*Figure 20*: Access to weather information by respondents according to gender

Source: Survey data (2016)

Multiple responses

The above findings show that the most utilized source of weather information is the radio. Majority of males used radio to obtain information about the weather. This was probably because majority of the males could afford the price of a radio. For example several of the females indicated at the focus group discussions that; *they usually used their experiences gathered over time or traditional knowledge to determine the future behavior of the weather*. When asked why they did not utilised the radio for such vital information, they said that:

> *There were no radio sets in their houses, it was only the mobile phones owned by their husbands that had radios and that they themselves did not have mobile phones. They said they usually use the phones of their husbands' for receiving and making*



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*calls. They also said that their husbands sometimes tell them about impending climatic risk such as expected drought or erratic rains.*

Personal observations and television were the next most utilized sources of information.

Radio and television are some of the most reliable sources of weather information in Ghana. These media are frequently used by the Ghana Meteorological Agency and the MoFA to communicate weather and agricultural information obtained from studies. According to Karuga (2015), the use of interactive radio has been helping to provide farmers in Ghana the much-needed information on climate and local weather, and the ways of strengthening their farming systems to cope with climate variation.

Thus with majority of males having access to relevant and reliable weather information, they will able to plan well by putting in place the appropriate measures that will lessen the adverse effects of climate variation. This probably explains why the majority of the respondents who suffered more from crop losses, food shortages, reduced incomes and high indebtedness were females as shown in chapter six. This is corroborated by the findings of Babugura, (2010) and Oxfam (2009) which indicate that, relative vulnerability of men and women to similar shocks and stresses is determined through the availability and access to resources such as weather information. Again the findings of Adiku, Mawunya, Jones, & Yangyuoru (2007) show that timely and reliable weather information through weather forecasts, seasonal forecasts, and early warnings of climate hazards facilitate farmers' preparedness for impending climatic challenges.



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***The relationship between gender and source of information***

Analysis was carried out using contingency test to find whether one's gender determined the source of weather information. The chi-square test and the symmetric measure showed there were gender dimensions with regards to access to weather information from the radio by cassava farmers (Tables 17 and 18). On the other hand, the test statistic for the relationship between the other sources and gender were not significant, even though there was evidence of gender dimensions in some of the sources of weather information as indicated in Figure 19. The positive test result of significance returned by both the chi-square and the symmetric measure indicating gender differences in the accessibility of weather information through radio by cassava farmers also support the alternative hypothesis which states that there are gender dimensions in the vulnerability of cassava farmers to climate variation. This is because a key determinant of vulnerability is access to credible weather information (Adiku et al, 2007; Babugura, 2010; Oxfam 2009; Karuga, 2015; Tiwari, Rayamajhi, Pokharel, & Balla, 2014; Nhemachena et al, 2007) and according to the finding radio is one of the most reliable sources of weather information used by the majority of farmers in the study area. Thus by extension, any gender difference in accessibility to weather information from radio which make one gender more disadvantage and hence more vulnerable to climate variation, implies a gender dimension in the vulnerability of cassava farmers to climate variation as shown by the findings of the present thesis.



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**Table 16: Cross tabulation of gender-based responses on radio as a source of weather information**

| | | | Yes | No | |
|---|---|---|---|---|---|
| Sex | Male | Count | 21 | 124 | 145 |
| | | Expected Count | 27.0 | 118.0 | 145.0 |
| | Female | Count | 26 | 81 | 107 |
| | | Expected Count | 20.0 | 87.0 | 107.0 |
| Total | | Count | 47 | 205 | 252 |
| | | Expected Count | 47.0 | 205.0 | 252.0 |

Source: Survey data (2016).

**Table 17: Chi-Square test of gender and radio as a source of weather information**

| | Value | Degree of Freedom | Asymp. Sig (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|---|---|---|---|---|---|
| Pearson Chi-Square | 3.910[a] | 1 | .048 | | |
| Continuity Correction[b] | 3.290 | 1 | .070 | | |
| Likelihood Ratio | 3.868 | 1 | .049 | | |
| Fisher's Exact Test | | | | .052 | .035 |
| Linear-by-Linear Association | 3.895 | 1 | .048 | | |
| N of Valid Cases | 252 | | | | |

Source: Survey data (2016).

**Table 18: Symmetric Measures of strength of association of gender and radio as a source of weather information**

| | | Value | Approx. Sig. |
|---|---|---|---|
| Nominal by Nominal | Phi | -.125 | .048 |
| | Cramer's V | .125 | .048 |
| | Contingency Coefficient | .124 | .048 |
| N of Valid Cases | | 252 | |

Source: Survey data (2016).



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The Pearson chi-square statistic (Table 17) tested the hypothesis that access to weather information through radio is the same for each gender (male and female). The significance value (asymptotic significance) determined the degree of difference. Typically, a significance value of less than 0.05 (1-sided) to 0.10 (2-sided) was considered "significant," suggesting there is a difference. The Symmetric measure (Table 18) quantified the strength of the variance. Phi was the ratio of the chi-square statistic to the weighted total number of observations. It was the most "optimistic" of the symmetric measures. As with the case of the asymptotic significance, a phi value (approximate significance) of less than 0.05 was considered significant.

***Gender and support from spouse***

Another criterion used to determine respondents' vulnerability to climate variation was the level of support received from spouses. Support or assistance received from spouses in farm management helped to reduce the level of vulnerability to the adverse effects of climate variation as observed by Dzah, (2011). Therefore, respondents were asked to indicate if they received support from their spouses while farming. Almost 71% said they had some support from their spouses; 5.2% did not respond to the question. Out of the total of 144 male respondents, 81% said that they always received some support from their wives on the farm. Some 56% of the 107 female respondents said their husbands supported them on the farm (Table 19).



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**Table 19: Support from spouse on cassava farming**

| | | | Do you get any assistance from your spouse | | | Total |
|---|---|---|---|---|---|---|
| | | | N/R | Yes | No | |
| Sex | Male | Count | 5 | 117 | 22 | 144 |
| | | % within Sex | 3.5% | 81.2% | 15.3% | 100.0% |
| | Female | Count | 8 | 60 | 39 | 107 |
| | | % within Sex | 7.5% | 56.1% | 36.4% | 100.0% |
| Total | | Count | 13 | 177 | 61 | 251 |
| | | % within Sex | 5.2% | 70.5% | 24.3% | 100.0% |

Source: Survey data (2016).

N/R = No Response

According to the findings, most of the males admitted receiving support or assistance from their spouse. Some of respondents also indicated that their spouses operated parallel businesses which augmented the income obtained from their farming activities. A male respondents from Senya-Breku said:

> "*My wife operates a provision shop and so she is supposed to support me with some finance when the farm does not perform well because drought or insufficient rains. So anytime my cassava farm failed as a results of drought she takes care of the children school fees and most of the household's financial responsibilities. She actually understands the situation.*"

Similar views were expressed by five other respondents one of which was a female. This implies that it is expectant of spouses to provide financial support to the husband/wives as a mechanism against the negative impacts of climate variation. Consequently, in the periods of bad harvest or total crop failure, they relied on the business operated by their spouses for survival. The majority of those who benefitted from such associations were males. This is corroborated by the study conducted by Dzah (2011), which indicated that women,



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particularly the married ones, have other responsibilities such as helping their husbands farming activities or on their farms. On the other hand, majority of the females said they never received any assistance from their spouses.

***Gender and access to land***

Land is the most priced asset in the study area. It is the most important natural resource on which survival of most households depended. The results indicate that thirty seven percent (37%) of the respondents had one farm land. Another thirty three percent (33%) had two farms, 19% had three farms, while 11% had more than three farms. An average of two farm were owned by a farmer (Figure 21).

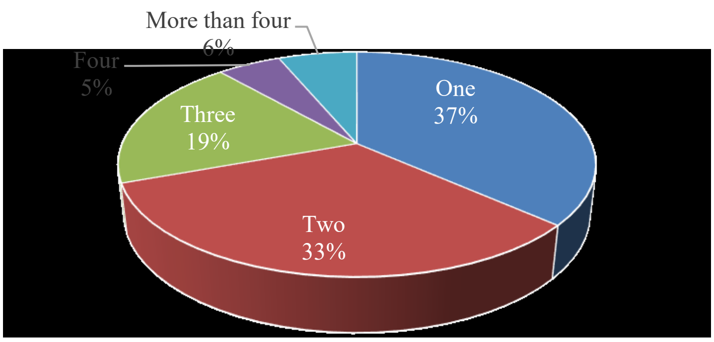


*Figure 21*: Number of farms owned by respondents

Source: Survey data (2016).

Multiple responses

In terms of gender disaggregation, there were more female farmers with one or two farms (Table 20). For example, 81.3% of the females had one or two farms compared to 55.2% of their male counterparts who had the same number of farms. On the other hand, more, males had three or more farms as indicated in Table 20.



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**Table 20: Gender distribution of access to farmlands**

Sex by farmland cross tabulation

| | | | One | Two | Three | Four | More than four | Total |
|---|---|---|---|---|---|---|---|---|
| Sex | Male | Count | 38 | 42 | 34 | 16 | 15 | 145 |
| | | % within Sex | 26.2% | 29.0% | 23.4% | 11.0% | 10.3% | 100% |
| | Female | Count | 50 | 37 | 10 | 5 | 5 | 107 |
| | | % within Sex | 46.7% | 34.6% | 9.3% | 4.7% | 4.7% | 100% |
| Total | | Count | 88 | 79 | 44 | 21 | 20 | 252 |
| | | % within Sex | 34.9% | 31.3% | 17.5% | 8.3% | 7.9% | 100% |

Source: Survey data (2016).

A chi-square test and symmetric measure to determine if the proportion of farmers having increased access to lands was the same across the two gender groups, returned a significant result at $P<0.05$ for both the Pearson chi-square asymptotic two-sided significance value and the Phi value of the symmetric measure (Table 21). The chi-square test results implies that there was significant difference in terms of increased access to land between male and female cassava farmers in the study area.

**Table 21: Chi-square test and symmetric measure of gender and increased access to farmlands**

Chi-Square Tests

| | Value | Degree of Freedom | Asymptotic Significance (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 20.543[a] | 4 | .000 |
| Likelihood Ratio | 21.330 | 4 | .000 |
| Linear-by-Linear Association | 16.730 | 1 | .000 |
| N of Valid Cases | 252 | | |

Symmetric Measures

| | | Value | Approximate. Significance. |
|---|---|---|---|
| Nominal by Nominal | Phi | .286 | .000 |
| | Cramer's V | .286 | .000 |
| N of Valid Cases | | 252 | |

Source: Survey data (2016).



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Data on the varieties of crops grown by farmers apart from cassava were obtained to ascertain how the number supplement crops affected the vulnerabilities from a gender perspective. Farmers cultivated a variety of crops that included maize, yam, sweet potato, plantain and vegetables (tomatoes, pepper, okro, egg plants). Maize was the most widely grown crop after cassava. About 79% and 30% of the respondents respectively cultivated maize and vegetables as supplementary crops to cassava. The remaining crops were cultivated by less than 12% of the respondents (Figure 22).

Maize was the preferred supplement crops because it had varieties that are climate-smart (drought tolerant and early maturing). These varieties, according to the farmers, are capable of producing average yields even with very little rainfall. Vegetables were also cultivated under irrigation and hence were not seriously affected by variations in the climatic elements.

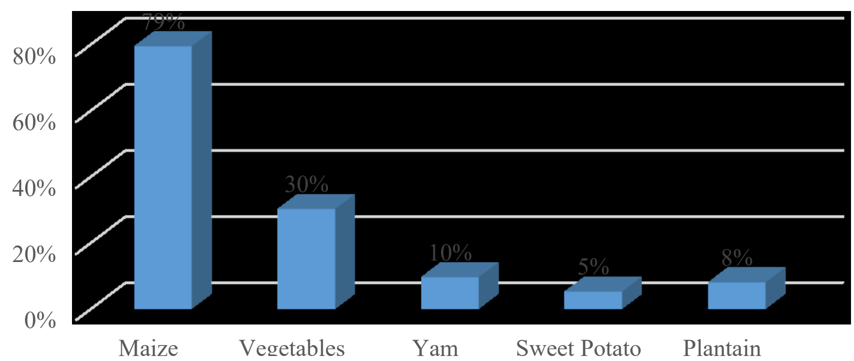


*Figure 22*: Crops cultivated by farmers apart from cassava
Source: Survey data (2016).

The majority of respondents who cultivated a minimum of two crops were males, while the female farmers were in the majority of the single crop growers (Figure 23). This was attributed to the fact that it was the males who had more access to land than the females.



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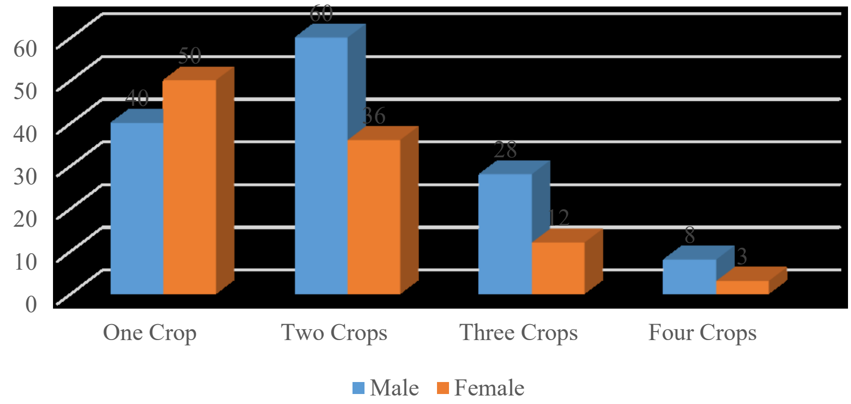


*Figure 23*: Gender-based distribution of the number of additional crops grown by farmers.

Source: Survey data (2016)

The findings show that the male farmers had increased access to land than the females since the males were the majority of multiple land owners. This has been reinforced by the results of the chi-square test which shows that the number of farmland owned by a farmer is dependent on whether the farmers was a man or a woman. In this particular case, the probability of having less number of farmland because a farmer is a woman is very high (95%). This confirms a claim by the male key informant from Awutu-Breku during an interview session. He said:

> *"By tradition, lands in Awutu-Brehu are owned by males who intend lease them out to others when they want. The lands are inherited or handed over to male members of the family except in cases where there are no male members in the family or in cases where the male children are too young then the wife/mother may take over the land or hold it in trust for the male child.*"



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The implication therefore is that majority of the female farmers were either renting the lands they were farming on or had access to the lands through their husbands or male children. This situation limits their access to land and considering that they are subsistence farmers, they will lack the necessary financial power to acquire more lands. It has been shown by Dzah (2011), Amondi (2012) and Röhr (2009) that access to land which facilitates crop diversification, either reduces or enhances one's vulnerability to the impacts of climate variation. Thus the chi-square test results weakens the position of the null hypothesis which states that there are no gender dimension in the vulnerability of cassava farmers to climate variation in the study area.

The findings also show that most of farmers are using crop diversification (cultivating a number of crops in addition to cassava) on as a means of mitigating against the detrimental effect of climate variation or reducing their vulnerability to the negative impacts of climate variation. The men were in the majority of this kind of practice. The probable reason could be due to women having less access to land. According to Amondi (2012), women tend to have limited access to physical, financial, human, social, and natural capital thereby increasing their vulnerability to climate variation. Röhr (2007) indicates that, women are less able to diversify and adapt to climate variations because of other domestic responsibilities and less control of financial and natural resources. Available evidence also indicates that crop diversification has been used as an adaptation strategy to moderate the effects of climate variation or reduce the level of vulnerability to climate variation (Smit et al., 2000). The risk of complete crop failure due to climatic events such as drought, intense rainfall or high temperature spells, is reduced by having different crops in the



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same field or various plots with differing crops since not all crops and fields are affected the same way by such climate events (Kasirye, 2013).

***Gender and household power dynamics***

The ability to take independent decisions, or influence decision making was used as a yardstick to determine the level of vulnerability of males and females. Power dynamics within the household, community, the society, and gender roles at large, are the major factors that control the ability of men and women to mitigate the effects of climate variations. This is supported by the studies of Babugura, (2010), Jungehülsing (2010), and the UNDP (2009b). As a result respondents were asked to indicate their level of participation in determining which crops to grow and at what time they planted the crops.

From Table 22, almost fifty-two percent (51.7%) of the male respondents indicated that it was the husband who was in charge when it came to making decisions about which crop to grow. Less than 7% of the husbands said it was their wives who made such decisions. Another 27.1% of men said it was a joint decision while 11% indicated that the decision was made based on the advice of the MoFA Agricultural Extension Assistants (AEAs). Some 16.8% of the women indicated that their husbands were responsible for making decisions. About 18.7% of the women indicated that it was the wives who took the decisions while another 32.7% said it was a joint decision.

On the whole, the majority of respondents (37.3%) said that the decision on what type of crop to grow and when to grow it was made by the husband. Again, from the gender perspective, majority of the responses indicated that it was the husbands who wielded more powers since 51.7% males and 16.8% females - a total of 68.5% were in favour of husbands as compared to 0.7%



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males and 18.7% females - a total of 19.4% who were in fovour of wives when it came to making decisions about the type of crop to grow and the timing of the planting date (Table 22).

**Table 22: Cross-tabulation results on decision making**

| | | | Who determines what crops to grow | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Husband | Wife | Both | Advice by MoFA AEAs | Others | Total |
| Sex | Male | Count | 76 | 1 | 40 | 16 | 12 | 145 |
| | | % within Sex | 51.7% | .7% | 27.2% | 11.0% | 8.3% | 100.0% |
| | Female | Count | 18 | 20 | 35 | 16 | 18 | 107 |
| | | % within Sex | 16.8% | 18.7% | 32.7% | 14.9% | 16.8% | 100.0% |
| Total | | Count | 94 | 21 | 75 | 32 | 30 | 252 |
| | | % within Sex | 37.3% | 8.3% | 29.7% | 12.6% | 11.9% | 100.0% |

Source: Field data (2016).

N/R = No Response

The chi-square test and the symmetric measure were employed to determine if decision making in the household was gender neutral. The results (Tables 23 and 24) show that decision making in the household was not gender neutral. According to the results, household decision making was highly dependent on gender. The results for both tests returned significant values (less than 0.05) indicating that household decision making was highly dependent on gender.

These outcomes further strengthens the alternative hypothesis that there are gender dimensions in vulnerability to climate variation.



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**Table 23: Chi-Square tests for gender and decision making**

| | Value | Degree of Freedom | Asymp. Sig. (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 49.198[a] | 4 | .000 |
| Likelihood Ratio | 54.386 | 4 | .000 |
| Linear-by-Linear Association | 10.875 | 1 | .001 |
| N of Valid Cases | 252 | | |

Source: Survey data (2016).

**Table 24: Symmetric measures of association: gender and decision making**

| | | Value | Approx. Sig. |
|---|---|---|---|
| Nominal by Nominal | Phi | .442 | .000 |
| | Cramer's V | .442 | .000 |
| | Contingency Coefficient | .404 | .000 |
| N of Valid Cases | | 252 | |

Source: Survey data (2016).

The above findings suggest that males are those in charge of decision making. This finding is supported by a statement reiterated by majority of the male respondents during interview sessions. They said that:

> *"Per our custom, women do not talk on important matters when men are present again men make decision about the family for women and children to follow."*

This statement strengthen the findings of the presents study on power dynamics and decision making which is in favour of the male gender. The statement sought to suggest that their wives' opinions were not sought when it came to making decisions about the wellbeing of the household. The women



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were therefore more vulnerable, since they were constrained in taking decisions they deemed appropriate for solving problems. The academic community also generally agreed that women's participation in decision making over resources use and management are limited in many societies as observed by Djoudi and Brockhaus, (2011). According to a study by Cooperative for Assistance and Relief Everywhere (CARE, 2011), vulnerability of women and children occur partly because they are left out and do not have a voice in decision-making on issues that directly impact on their lives. People in discomfort situations, or facing potential risks are the better judges of the appropriate actions that could bring relief to them or avert the impending risks.

**Climate Variation and Gender-Based Vulnerability**

To address objective three which was to identify the more vulnerable gender to the adverse effect climate variation, respondent are asked to indicate in their own view point the more vulnerable gender to the adverse effects of climate variation. Dankelman (2010) notes that although variations in climate affects everybody, it is not gender neutral. Ahmed et al (2009) has also observed that climate variation will affect people across the world; however, certain groups are likely experience severe consequences than others resulting in differential in vulnerability levels. According to the findings of the present thesis, the female gender was found as more vulnerable to the effects of climatic variations according to the respondents' viewpoints. About 45% of the male respondents and 83% of the female respondents (Figure 24) said that females were more vulnerable to the effects of seasonal climatic variation. On the other



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hand, 46% of the males and 12% females said that males were the more vulnerable gender.

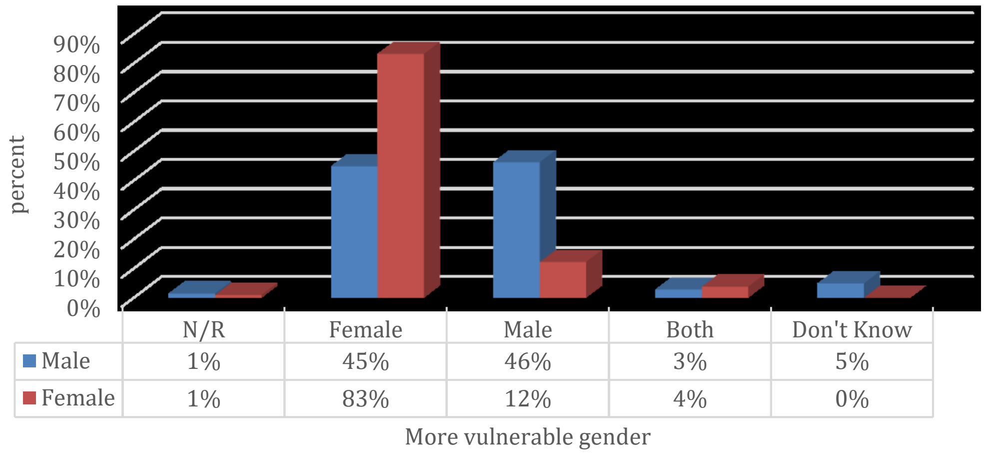


*Figure 24:* Gender and vulnerability to the effects of seasonal climatic variation
Source: Survey data (2016)

A chi-square test and symmetric measures to determine if there are no gender dimensions in the vulnerabilities to climate variation returned positive results (Tables 26 and 27). The two-sided asymptotic significance of the chi-square statistic and the approximate significance of the symmetric test were all less than 0.05 (Asymptotic significance. 2-sided =0.000; Approximate significance=0.000). This indicates a difference in the vulnerability to climate variation across gender.

Thus on the whole the positive results returned by both the chi-square tests and symmetric measures support the alternative hypothesis which states that there are gender dimensions in the vulnerability to climate variation by cassava farmers with the females being more vulnerable as indicated by the findings of the study.



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. Hence the null hypothesis which states that there are no gender dimensions in vulnerabilities to climate variations by cassava farmers is rejected on the basis that available evidence does not support that assertion and conclude that there are gender dimensions in the vulnerabilities to climate variation by cassava farmers.

**Table 25: Cross tabulation of the more vulnerable gender to climate variation**

| | | | Female | Male | Both | Don't Know | Total |
|---|---|---|---|---|---|---|---|
| Sex | Male | Count | 67 | 67 | 4 | 7 | 145 |
| | | % within Sex | 44.8% | 46.2% | 2.8% | 4.8% | 100.0% |
| | Female | Count | 90 | 13 | 4 | 0 | 107 |
| | | % within Sex | 83.2% | 12.1% | 3.7% | 0.0% | 100.0% |
| Total | | Count | 154 | 80 | 8 | 7 | 252 |
| | | % within Sex | 61.1% | 31.7% | 3.2% | 2.8% | 100.0% |

Source: Survey data (2016).

**Table 26: Chi-square tests: gender and vulnerability to climate variation**

| | Value | Degree of Freedom | Asymp. Sig. (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 42.045[a] | 3 | .000 |
| Likelihood Ratio | 47.230 | 3 | .000 |
| Linear-by-Linear Association | 27.785 | 1 | .000 |
| N of Valid Cases | 252 | | |

Source: Survey data (2016).

**Table 27: Symmetric Measures of association: gender and vulnerability to climate variation**

| | | Value | Approx. Sig. |
|---|---|---|---|
| Nominal by Nominal | Phi | .408 | .000 |
| | Cramer's V | .408 | .000 |
| | Contingency Coefficient | .378 | .000 |
| N of Valid Cases | | 252 | |

Source: Survey data (2016).



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The above results support findings of earlier literature. For example the UNDP (2009a) indicates that the vulnerability to climate variation among males and females "depend on the comparative disadvantage of each gender ability to cope with, recover from, or adapt to the variations in climate". Denton (2002) and Skutsch (2002) state that women will be more vulnerable than men to the effects of climate change because of unequal power relations, limited access to resources (financial, natural, social, human), information and economic opportunities. This is confirmed by the qualitative responses of the males which indicated women and children in the households are governed by decisions taken by the men. In addition to the subordinate positions of women and children, their roles in society as well as the cultural norms that govern their lives as demonstrated by the current findings make them more vulnerable to the adverse effects of climate variation. Dzah (2011) has also confirmed that the educational gap between males and females with the latter being more disadvantaged has heighten to their vulnerability to climate variation.

One of the key factor of women's vulnerability to climate variation in agriculture is access to land. This resource is the most priced asset to the farmers. Land was described by the respondents as the most important natural resource on which survival of most households depended. Access to land in the district was gender biased. Majority of the male respondents had more than one farm. This was not the case with the female respondents, the majority of whom had just one farm. The findings indicated gender disparity with regards to access to land. This was largely due to their system of land acquisition in the study area which was in favour of the males as indicated by the male key informant from



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Awutu Breku. This has been supported by the finding of the FAO (2012) which highlighted gender inequalities while commenting on access to land in Ghana.

According to the FAO (2012), it is male descendants, even from the matriliny who make the decisions which often result in lower access to and the use of land by women. Dzah (2011) has observed that in most cases in Ghana, men have better access to land than women.

With increased access to land which enhances greater diversity in crop production (Dzah, 2011), the risk of complete crop failure (because of climate variation) can be reduced (Bradshaw, Dolan, & Smit, 2004 and cited in Dzah, 2011). The reason is that some crops have the ability to withstand drought or produce good yields under sub-optimal climatic conditions than others. The land could also be rented out during periods of financial difficulties, or used as collateral for loans as was observed by Dzah (2011). The implication is that, with limited access to land, the female farmer will not able to expand and cultivate a variety of crops to serve as mitigation strategy against the adverse effects of climate variation. This make them more vulnerable to the consequences of climate variation.

Respondents were asked to give reasons why they regarded the other gender as the more vulnerable to the effects of seasonal climatic variations. Various reasons were given and those that were in favour of the female as the more vulnerable gender are as follows:

- A total of 68 respondents of which 15% were males and 85% females said that women are the bread winners of the house. As such, any adverse effects of seasonal climate variation on their major source of income would make it very difficult for them to manage the home.



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- Some 98% females and 2% males indicated that women depend mostly on farming as their major source of income. This makes them more vulnerable to the adverse effects of seasonal climate variation.
- One male respondent said that, women are less capable of managing crisis and this often affects their vulnerability.

The reasons for the male being the more vulnerable gender to the effects of seasonal climatic variations are as follows:

- A total of 43 respondents of which 98% were males said that, men are the bread winners of the house, hence effects of seasonal climate variation on cassava production adversely affects their income.
- A total of 44 respondents of which 66% were males and 34% females indicated that the climate variations affect the income of men. That is what makes them the more vulnerable gender.
- Women can easily get other jobs such as petty trading and hawking, but the men cannot.

**Women and Cassava Farming**

The study also sought to find out if women should engage in cassava cultivation (Table 28). This was to find out how people of the study area thought of the duties of men and women. Majority of the male respondents (55.2%) thought that cassava farming is not a woman's job. Some 38.2% females too thought that cassava farming is not meant for women. Some of the reasons given by the respondents as to why women should not engage in cassava farming are as follows:



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- it is not good for their health
- it is too difficult for women
- women are too weak to engage in cassava farming

**Table 28: Respondent thoughts of whether women should engage in cassava faming or not**

| Sex | Do you think women should be in cassava farming | | | | | |
|---|---|---|---|---|---|---|
| | | N/R | Yes | No | Don't Know | Total |
| | Count | 4 | 54 | 80 | 7 | 145 |
| Male | % within Sex | 2.8% | 37.2% | 55.2% | 4.8% | 100.0% |
| | Count | 5 | 54 | 41 | 7 | 107 |
| | % within Sex | 4.7% | 50.5% | 38.3% | 6.5% | 100.0% |
| Female | Count | 9 | 108 | 121 | 14 | 252 |
| | % of Total | 3.6% | 42.9% | 48.0% | 5.6% | 100.0% |

Source: Survey data (2016)

N/R: No Response

The results affirms the findings of Babugura, (2010) which reveals that women's subordinate positions and roles in society as well as socio-cultural norms that govern their lives limit their choices. These socio-cultural norm have one way or the other helped in the development of the assertion that women are weak and cannot perform certain types of jobs.

Majority of the farmers were of the view that cassava farming was not suitable for women, this conclusion could be derived from the social norms and believe that women are the weaker sex and hence cannot engage in occupations that are deemed to be labour intensive such as cassava farming (WAAPP, 2017). This is supported by OSAGI (2001) which stated that there are differences in roles and responsibilities, in rights, opportunities, and all the social attributes associated with being male or female determined by legal, social institutions and culural norms.



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**Summary**

The chapter has described the variation in the main climate elements- rainfall and temperature at three stations in the study area. It has also presented the results and discussions of the farming experiences of respondents, gender dimensions of respondent's perceptions about climate variation and their vulnerability to the adverse effects of the climate variation.

The results showed variation in the rainfall pattern and increasing temperature trend over the 30 year period, giving evidence of climate variation. The findings also indicated that the majority of farmers have been farming in the various communities for 10 years and over. The results showed diversity in the perceptions of climate variation. Respondents attributed variations in the climatic elements to environmental degradation. Some, natural phenomenon, and punishment from God. It was noticed that, factors such as age of respondent, period of stay in the study area, and educational level of respondent play significant roles in the formation of respondents' perceptions. In addition, the findings have shown that social group affiliation has helped in the shaping of farmers' perceptions of climate variation in the study area. These observations affirm the findings of Oremo (2013) that farmers 'affiliation to an association is central to the development of their adaptive capacity.

There were gender disparities with regard to respondents' opinions about the possible causes of seasonal variations. The majority of those who associated changes in seasonal variations to environmental degradation were males. It was also the males whose perceptions about the variation of the climatic elements were consistent with the trend in the climatic data of the study area. One of the reasons why the males were more accurate in their perceptions



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of climatic occurrences than the females was due probably to the level of their educational backgrounds as observed elsewhere by (Dzah, 2011).

Results further indicated that, the most common source of weather information accessed by farmers was the radio. There were gender differenced in the various sources of weather information. Majority of the males obtained their weather information from radio broadcast, while the females mostly relied on AEAs. A chi-square test and symmetric measure indicated gender differences in access to weather information from the radio. Males had more landing holdings than females. A chi-square test proved the presence of gender dimensions in access to land with the females being at a disadvantage. With regard to the support from spouse and decision making, the males were the main beneficiaries. Most of the respondents also said it was the husband who decided on what type of crop to grow and when to grow

On the whole the female gender was more vulnerable gender group. Farmers' vulnerability to climate variation was obvious due to the fact that all of the respondents practiced rainfed agriculture, however, the levels of the vulnerability of individuals or group were determined by pre-disposing factors such as education, age and access to resources, information, power dynamics and support services.



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# CHAPTER SIX

# GENDER-BASED ADAPTATIONS TO THE ADVERSE EFFECTS OF CLIMATE VARIATION

## Introduction

This chapter presents the results and discussion on the gender dimensions of the effects of climate variation on cassava production and the adaptations strategies used by farmers to combat the adverse effect in the study area. Results on gender dimensions of the effects of seasonal variations on cassava farmers such as decreasing cassava yields, delayed harvesting and increased incidence of cassava-root rots, crop losses and on delayed planting are presented. In addition, the chapter presents the findings on gender dimensions of adaptions to the effects of climate variation. Findings from the study on the various adaptation strategies employed by farmers to mitigate the effects on the climate variation are outlined. Results on the application of the adaption strategies from gender viewpoint are also presented. Results of the analyses that re-enforces the relationships between gender, vulnerability and adaptation strategies using chi-square test and symmetric measure are presented. Evaluation of the results and the significance of the finding are presented alongside the results. Findings emanating from the results of the study are evaluated against previous findings from elsewhere. The implications of the finding on the farmers and on cassava production as a whole in the study area are stated.



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**Effects of Variations in Climate on Cassava Production**

This section addresses specific objective four which sought to find out the extent to which the variation in the climate has affected cassava production in the district. Agriculture is an economic activity that is highly dependent upon weather and climate (Van Vuuren, Ochola, Riha, Giampietro, Ginzo, Henrichs, ... & Kuppannan,2009). Climate variations affects crop cultivation in a number of ways, such as through changes in average temperatures, rainfall and climate extremes with an important impact on soil erosion (that is, floods, drought), changes in pests and diseases, proliferation of weeds and changes in growing season (World Bank, 2008). According to MoFA (2008), agricultural in Ghana is still highly dependent on rainfall, making the production of crops rely entirely on the weather. Abubakari & Abubakari (2015) confirms that climate variation is a threat to agriculture and food security because of the loss of crops through variation in rainfall and temperatures.

As indicated in chapter five, Awutu Senya district is experiencing variation in climatic elements with variation in the rainfall pattern and increases in temperatures over a thirty-year period from 1984 to 2014. To find out the extent to which climate variation has affected cassava production in the study area, personal observations of respondents with regard to the effects of the variations in the wet and dry seasons on crop yields, labour cost, outbreak of pest and diseases, and delay in sowing and harvesting times were discussed/solicited from the farmers. Others included crop losses, debt increase and financial burdens. Observations of respondents indicated that variations in temperature and rainfall patterns affected cassava production.



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Results (Figure 24) are that, the majority (97%) of the respondents said they suffered from decreasing yields in cassava over the years as a result of seasonal variations in temperature and rainfall. This is consistent with the observations of Mendelsohn, Dinar, & Williams (2006) which indicate that extreme temperatures and prolonged drought periods in Ghana were the major causes of low crop productivity. This has been corroborated by the findings of Stutley (2010) which states that extreme temperatures and erratic rainfall in Ghana are a source of low yields in the crop production.

Next in rank was delayed harvesting, where 80% of the respondents said they had to delay harvesting their crops for the ideal climatic conditions to set in. This is what some respondents said.

> "*There is usually one rain in the dry season which softens the soil and makes harvesting easy and when this rain delays they necessarily have to delay harvesting otherwise there will be significant tuber losses or high labour cost associated with harvesting." They further indicated that; "a prolonged dry period after this rain makes processing of cassava into aglema and flour very easy by providing adequate sunshine and dry weather.* "

Seventy percent (70%) indicated that the suffered crop losses as a result of variations in the climatic elements. Only 6% of the respondents indicated that they had to delay the sowing of crops due to the late onset of the rainy season, an action which respondents claimed affected the harvesting time and the quantity of the harvested tubers. Although other adverse effects such as increased incidence of cassava tuber-rots, delayed planting and difficulty in harvesting affected farmers (Figure 25), these adverse effects from the seasonal



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variations were not as common among respondents as the first three (decreasing yields, delayed harvesting and crop loss).

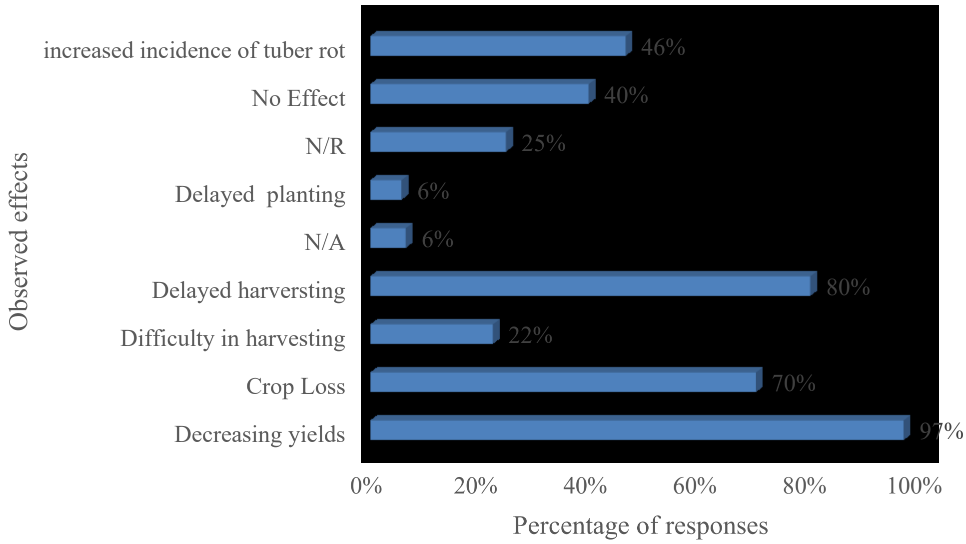


*Figure 25:* Effects of seasonal variations on cassava production

Multiple responses

Source: Survey data (2016).

N/A = Non-Applicable

N/R = Non-Response

Both male and female respondents reported some indirect adverse effects of the changing weather patterns on cassava production as shown in Figure 26. The indirect effects were as a results direct effects such as reduces yields, crop failure, delayed planting, delayed harvesting and increased incidence of pests and diseases. Some indirect effects manifested themselves in the reduction of the incomes from cassava proceeds, in food shortages and in increased indebtedness caused by poor yields resulting mainly from the outbreak of pests and diseases. For example, 47% of the respondents said that they suffered reduced incomes from the proceeds of cassava, while 33%



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experienced food shortages due to low yields or total crop failure due to seasonal variations in the rainfall pattern. A few respondents (9%) had their debt situations worsened due to complete crop failure (which they attributed to prolonged drought), while 8% experienced very poor yields because of proliferation of pest and diseases caused by excessive rainfall. These findings are in line with that of Bebbington (1999) who has observed that extreme weather events such as droughts, high temperatures and erratic rainfall would greatly deplete the financial resources of those who heavily depend on agriculture, a climate sensitive sector, for their livelihoods by destroying crops. Again, Ampaabeng & Tan (2012) state that climate variation increases the incidence of pests and diseases in crops posing serious threats to crop yields, human health and the attainment of livelihoods.

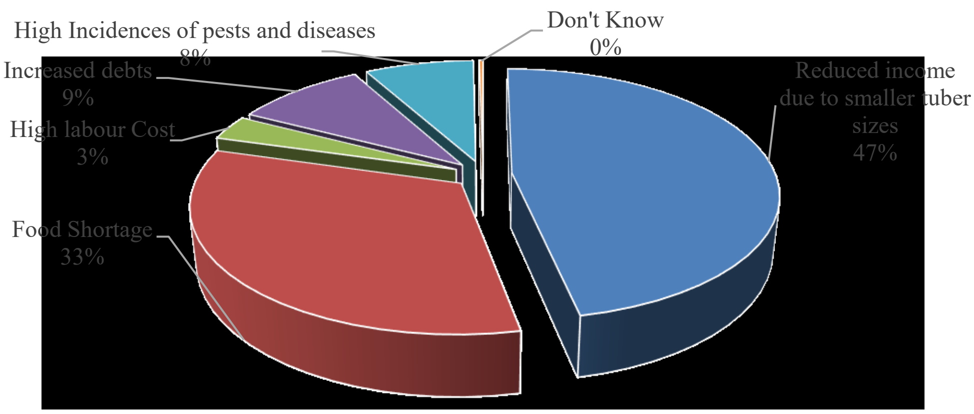


*Figure 26:* Indirect effects of seasonal variation on cassava production

Source: Survey data (2016)

The study sought to determine the effects of favourable and unfavorable climatic conditions on both the yield of cassava and the income earned by farmers from the crop's production. Favourable conditions imply when rainfall both in duration and amount were in sufficient quantities. That is the normal 8



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months of rainfall in sufficient quantity for crop cultivation. Unfavourable conditions on the other hand imply seasons with low amounts of rainfall, long periods of drought, dry weathers and high temperatures, and erratic rainfall.

Concerning the yields realised, respondents were asked to state the yield of cassava per acre under favourable and unfavourable climatic conditions. Yields were scored based on the following criteria; "high" represented "above normal yield", "moderately high" referred to "just above normal yield", "moderate" meant "normal yield", "moderately low" represented "just below normal yield" and "low" referred to "far below normal yield" on the Likert scale. Normal yield according to MoFA (2014) was 17t/ha which was about 204 maxi bags/ha.

Responses (Figure 27) shows that, under favourable weather conditions, 14% obtained high yields per hectare averaging above 270 maxi bags/ha, while 1% obtained high yield under unfavourable weather conditions; 40% obtained moderately high yields per hectare averaging between 270-230 maxi bags/ha under favourable weather conditions. There were no responses on unfavourable conditions. But 27% said they obtained normal yield (17t/ha) or 204 maxi bags of cassava per every hectare cultivated under favourable weather conditions while 29% said they obtained normal yield under unfavourable conditions. Some 17% recorded moderately low yields per every hectare that is below 150 maxi bags to about 80 maxi bags under fovourable climatic conditions but under unfavourable climatic conditions 69% recorded moderately low yield.



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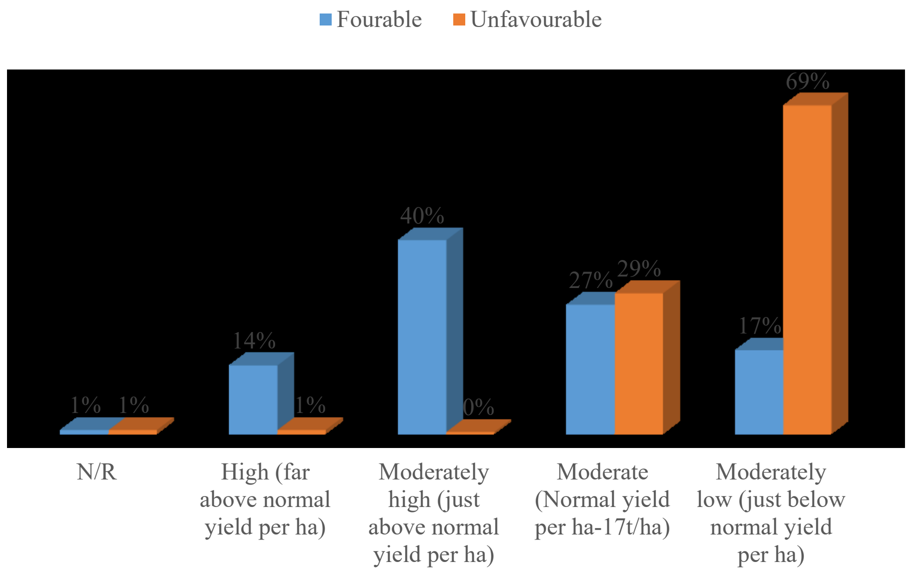


*Figure 27*: Effects of favourable and unfavourable weather conditions on cassava yield

Source: Survey data (2016)

On the effects on finance (Figure 28), 40% of the respondents indicated that they earned incomes from GH¢100 to GH¢1,900/ha under favourable conditions while 76% of the respondents indicated they earned incomes within the same range under unfavorable condition. When it came to the earning of higher income under favourable and unfavourable weather conditions, majority said that they earned higher incomes (GH¢2,000 and above)/ha under fovourable weather conditions (Figure 28).



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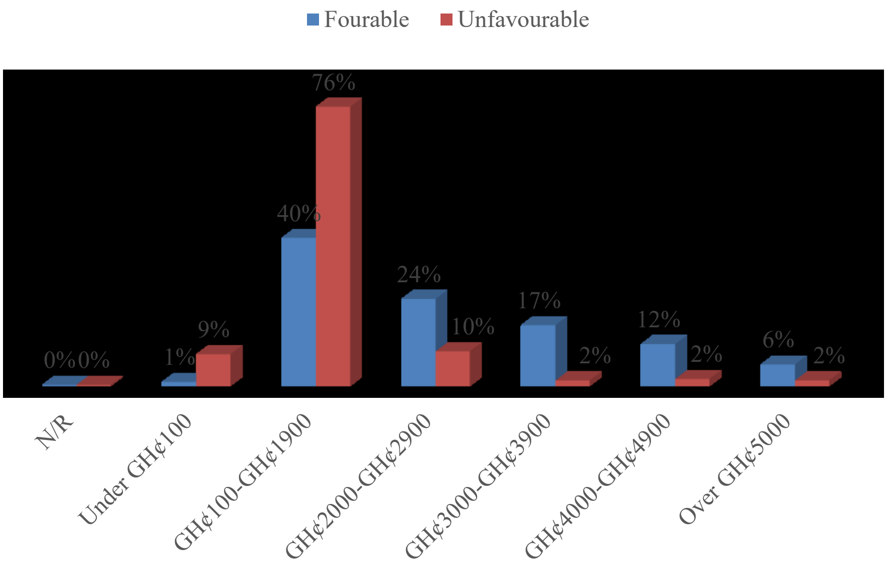


*Figure 28*: Seasonal climate variations and earnings from cassava production per hectare

Source: Survey data (2016)

N/R = Non-Response

It can thus be seen from the finding that, declining precipitation and temperature increases as shown in chapter five, present serious challenges to the cassava farmers since they depend entirely on rainfall for crop production and other rural livelihoods. High temperatures increase evapo-transpiration that leads to reduction in soil moisture content. Even though temperature is important for crop production, rainfall is a critical element for crop production in the tropics (Sivakumar, Das & Brunini, 2005). Perhaps, this could be attributed to the fact that the lack of, or excess of rainfall over a long period, leads to either drought or flooding that can reduce crop production, and hence to food shortage and income reduction (Haile, 2005).



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Adverse effects of climate variabilities on cassava production are manifested in yield decreases, delayed harvesting of crops, and frequent crop losses. These results are backed by the facts that high temperatures, decreasing or erratic rainfall, and reduced rainy periods, or longer dry seasons and extended drought periods were some of the frequent seasonal climate events observed by respondents in the Awutu-Senya District as shown earlier in chapter five. Almost every farmer experienced decreasing yields over the years because of erratic rainfall, extended drought periods, unusually high temperatures and intermittent floods caused by occasional heavy down-pours. Available evidence also suggests that these adverse climatic events negatively affect cassava production. For example, too much water or flooding, promotes cassava root-rot and the proliferation of pests. All these combine to affect yields as Moses, Asafu-Agyei and Ayueboteng, (2005) have observed.

Respondents indicated that they had to delay the harvesting of their crops by staggering the sowing time of their crops. Seven out of every ten respondents endured some crop loss as a consequence of severe droughts and high temperatures. These findings are supported by Cock (1985) who claimed that temperatures above or below certain thresholds have considerable effects on cassava growth, as it affects sprouting and ultimately, tuber yield.

Incomes of farmers from cassava production were also partly affected by seasonal variations. Most of the respondents said incomes from the sales of cassava continued to reduce due to poor yields caused by drought and erratic rainfall. Some of the respondents said that they incurred debts and were unable to repay the loans they took to invest in their farms because of poor harvest or crop failure. The impact of climate variation on farmers' income is influenced



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by changes in actual yields (Reidsmaa, Ewert , Lansink & Leemans, 2009).

## Gender Dimensions of the Effects of Seasonal Variation on Cassava Production

Since the study explores the gender dimensions of the adaptation to climate variation, gender based analysis of the effects of climate variation of cassava production was carried out. According to Vorsah (2015), gender based analysis of climate variations impacts on crop production is necessary to understand how the identities of women and men determine different vulnerabilities and capacities to cope with climate variation impacts and also how to tackle both the causes and consequences of the variation.

The effects of climate seasonal variations on cassava farmers from gender perspective reveal disparities (Figure 29). This is supported by Ali, Deininger, & Markus (2011) who observed that gender differences exist with regard to the impacts of climate variation on agriculture, with males and females facing different risks and vulnerabilities, and at different levels. According to the findings, adverse effects such as decreasing cassava yields, delayed harvesting and increased incidence of cassava root rots were reported by the majority of the male respondents. On the other hand, the majority of females reported on crop losses and on delayed planting. For example, 99% of the males compared with 95% female respondents (Figure 29) experienced decreasing yields from year to year because of seasonal variations in the climatic elements. Again, eighty-six percent (86%) male respondents and 72% of the female respondents often delayed the harvesting time of cassava either because of extended drought period, or because of the delay in the onset of the rainy season.



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The results (Figure 29) indicate that, 50% male respondents and 41% females said they experienced root rot due to excessive rainfall.

There were instances where more females suffered adverse effects caused by seasonal variations than the males. For example, 72% female respondents reported that they experienced crop losses as a result of drought or too much rains, while 69% male respondents experienced the same effect caused by drought or too much rains. Seven percent (7%) females compared with 5% males had to delay the planting time as a result of extended drought period. More females (49%) indicated that they suffered no adverse effects from seasonal variations. These findings clearly show different experiences by males and females with regard to the adverse effects caused by seasonal variations in the climatic elements.

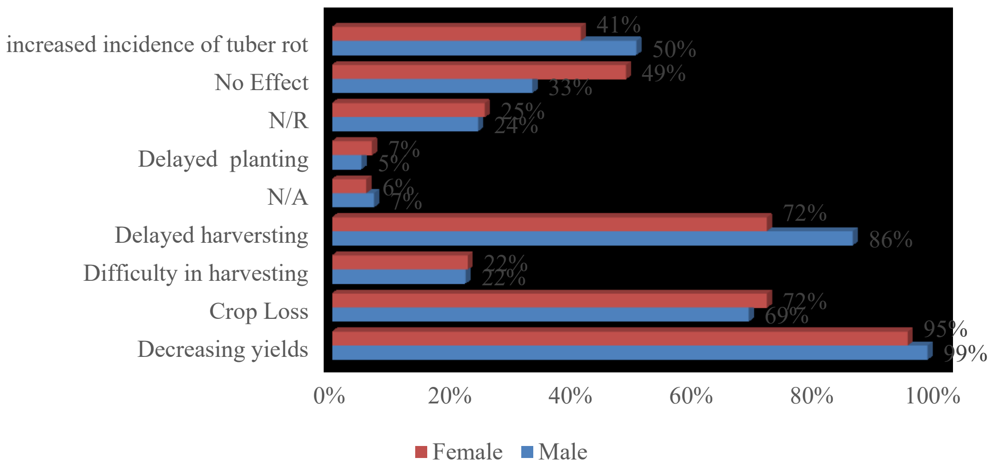


*Figure 29*: Seasonal climate variation and cassava production by the different gender group.

Source: Survey data (2016)

Multiple responses

There were some related cases the effects of seasonal climate variations on cassava production such as reduced incomes due to smaller tuber sizes, food



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shortage, high labour cost, increased debts, and high incidence of pest and diseases (Figure 30). There were also gender differences regarding the indirect effects of seasonal variations on cassava production. The majority of females reported cases of reduced incomes (78%) and increased indebtedness (16%) due to smaller tuber sizes and high incidence of pests and diseases. On the other hand, it was the majority of the males who reported of food shortage and labour cost due to poor crop yields and proliferation of weeds on farms. For example, during group discussion sessions with the females, they said that:

> *Between the farming seasons of 2012 and 2013, thy suffered crop failures due to improper timing of the raining season and also using crops that were not drought resilient. As a results they virtually had no money to support their husbands in the running of the households. Some of them had to rely on borrowing of money which was not sufficient. This situation affected the food supply to the house. The children suffered a lot. Their education also was affected since they were constantly being sent home to come collect school fees because they were running late in their payments of the school fees.*

On the other hand the males also complained that:

> *Periods of low yields affected their ability to provide three square meals for the house. This situations usually affects their income so badly that they are unable to meet their financial obligations to the households which indirectly affects the entire family.*



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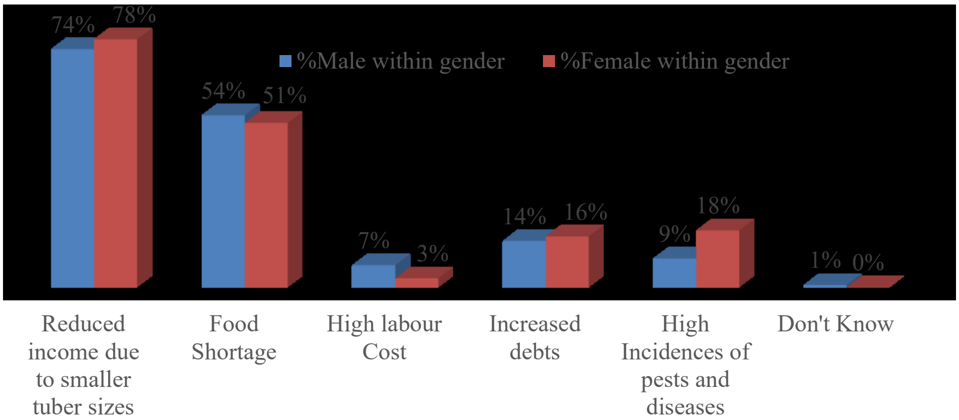


*Figure 30*: Other gender-based effects of seasonal climate variation on farmers.

Source: Survey data (2016)

Within Gender Analysis

In terms of the effects of favourable and unfavourable weather conditions, some gender dimensions were observed (Figure 31). Although both male and female farmers suffered some effects on yield that emanated from weather challenges, the majority of males reported high and moderate cassava yields per ha under favourable weather conditions. Fifteen percent (15%) of the males compared with 13% of females reported high cassava yields per hectare (ha) under favourable weather conditions; again 32% males compared with 21% females reported moderate cassava yields per ha under favourable conditions. On the other hand, the majority of females reported moderately low and low yields of cassava per ha, that is between 150-20 maxi bags/ha under favourable weather conditions. The number of reported cases for moderately high yields under favourable weather conditions was almost even across the two gender groups (41% for female and 40% for males). Under unfavourable weather



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condition, the number of reported cases were insignificant for both males and female with regard to high and moderately high yields. This implies that yields were very poor under the hash climatic conditions. However, with respect to moderate and moderately low yields; more females reported moderate yields while more males reported moderately low yields (Figure 31).

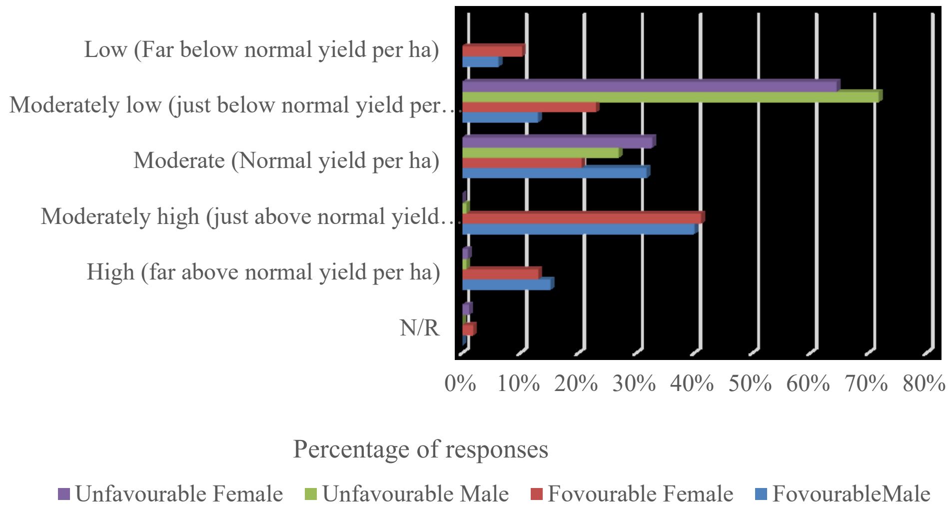


*Figure 31*: Gendered responses to cassava yields according to favourable and unfavourable weather conditions

Source: Survey data (2016)

Within Gender Analysis

The effects of seasonal variations in temperature and rainfall on income have some gender disparities. For example, there were more females earning less than GH¢100 to GH¢1900/ha under both favourable and unfavourable weather conditions (Figure 32). But as one moves into the higher income earnings, majority of the respondents earning above GH¢1900/ha from cassava proceeds were males, under both favourable and unfavourable weather conditions.



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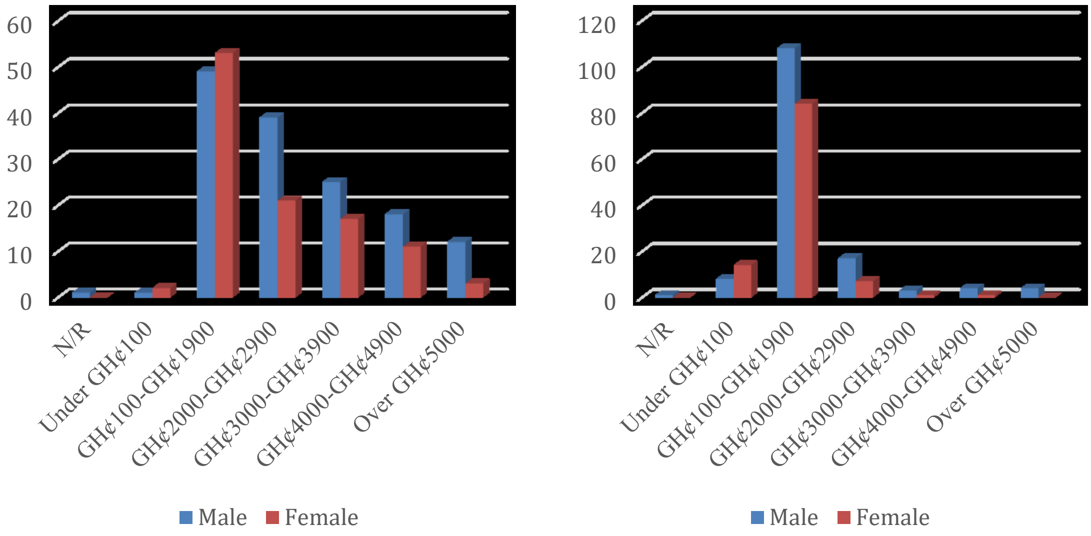


Favourable weather conditions earnings/ha | Unfavourable weather conditions earnings/ha

*Figure 32:* Gender and effects of seasonal variation on income

Source: Survey Data (2016)

Within Gender Analysis

The above findings suggest that, the situation where the majority of females were those badly affected by crop losses, reduced incomes due to smaller tuber-sizes, increased debts and high incidence of pests and diseases could be attributed to their poor financial base and low educational background. According to the findings, the males owned more farmlands than the females. Majority of the males had farm ranging from two to more than four farms compared to the females with an average of two farms. The results also indicated that it was the female gender which had majority of its members with no or very limited educational background.

The larger assets of the males strengthened their financial base which probably enabled them to cope well with variations in the climatic elements than



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the females. This is corroborated by the findings of Brouwer et al. (2007), Gbetibouo (2009), Deressa et al., (2009) and Bryan et al. (2013) which say that, the lack of resources or assets to be used to adopt practices that would minimize risks to climate variation impacts could increase effects of climatic impacts. The findings also agree with that of Goh (2012) which reveal that, climate variation could have greater consequences with gendered nuances for farmers with smaller income base. The findings of the presents study further revealed that, it was the majority of the males who were able to delay the harvesting of their crops. This suggests that, the females did early harvesting even during unfavourable weather conditions due to financial pressure, since their asset-base is smaller, compared to their male counterparts. This is confirmed by majority of the female respondents during group discussion sessions who indicated that;

> *they usually harvest some of the cassava within five months of planting to either sell for money to support the family up keeping or use as food in the house instead of the normal 8 to 12 months after planting depending on the variety*.

The findings further revealed that while the adverse effects of climate variation affected the females capacity to support the running of the house, the males on the other hands could not adequately meet their financial obligations to the family and the children also had to endure food rationing and the embarrassment of being sacked from schools due to their inability to pay school fees on time. This demonstrates an aspects of gender dimension of the effects of climate variation on cassava farmers. These findings are consistent with Goh (2012) findings.



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Disparities existed between gender groups with regards to income accruing to them from the proceeds of cassava. According to the findings, majority of the female farmers earned incomes from under GH¢100 to GH¢1,900/ha in both favourable and unfavourable weather conditions while the males earned between GH¢2,900 and over GH¢5,000/ha from cassava sales under the same conditions. The reasons for these disparities can also be attributed to the gender difference in the access to land. The males have advantage over the females in terms of access to land as alluded to by the male opinion leader from Awutu Breku during an interview session. As a result, the males were able to make more income from large or multiple farmlands than their female counterparts irrespective of the weather conditions. This findings confirms those of FAO (2012) that indicates that, in Ghana, men hold 3 times more farms than women, and 8 times medium and large-sized farms (of 5 acres or more) due cultural norms that favour male ownership of land over females. Findings suggest that asset accumulation is very essential for tackling the adverse effects of climate variation. As a results equity in access to land for both male and female is crucial for addressing climate variation effects among farmers.

The magnitude of the adverse effects suffered by each gender was assessed using the level of support individual farmers received from their spouses. According to the findings, majority of the males received support either financially, or on the farm, from their wives than the female counterparts. That meant that, the males were more likely to alleviate the full effects of climate variation than the female farmers due to the support they received from the spouses. Hence the majority of female farmers bore heavier burdens



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emanating from the consequences of climate variation on cassava production as compared to the male farmers. The findings confirms Dzah (2011) assertion that women, particularly the married ones, have other responsibilities such as helping husbands on their farms. This phenomenon could probably explain some households' power dynamics between men and women which tend to influence the differences in the shocks of climate variation experienced by men and women (Carr, 2008).

**Adaptations and Coping Strategies of Farmers to Seasonal Climate Variations**

The main focus of the present study was to explore the gender dimensions of adaptations to climate variations by cassava farmers in the Awutu Senya district. As such analysis of adaptations and coping strategies of farmers was carried out. The results reveal that, because of the changes in weather conditions during particular seasons, farmers in the study area used various strategies to cope with or adjust to the challenges brought about by the variation. Adaptation is key for the enhancement of a resilience to a vulnerable system (Stakhiv, 1993; Bohle et al., 1994; Burton et a.,, 1993; Smit et al., 2000; IPCC 2001). The ability to develop effective adaptation strategies that may lead to resilience is dependent upon the availability of the means, which according to Eisenack and Stecker (2012), are resources, opportunities, alternative choices, information, improved technologies and institutional arrangements. Hence to find out how farmers adjusted to the changing rainfall patterns, respondents were asked to indicate the actions they took to cope with such conditions.



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Table 29 presents the list of the various strategies adopted by the respondents. The majority (87%) said they usually schedule the planting time to correspond with the rainy season. The next most used copping strategy was the cropping of different cassava varieties in the same growing season. Another widely used adaptation strategy was bush fallowing, where part of the land was left fallowing for a period of time with the aim of restoring the fertility of the soil. During the fallow period, the farmer cultivated one section of the farm land. The reason for this practice as indicated by the respondents was that, after the fallow period the land became very fertile and required very little or no inorganic fertilizer to give maximum yield, even with limited amount of rainfall.

**Table 29: Gender-based adaptation strategies used by cassava farmers to withstand or mitigate the effects of climate variations on cassava production**

| | Multiple Responses | | | | | |
|---|---|---|---|---|---|---|
| Action | Male | % within male | Female | % within female | Totals Responses | % within gender total |
| Change planting date | 125 | 88 | 91 | 86 | 216 | 87 |
| Use different cassava varieties | 78 | 55 | 67 | 63 | 145 | 58 |
| Increase farm size | 3 | 2 | 8 | 8 | 11 | 4 |
| Decrease farm size | 2 | 1 | 6 | 6 | 8 | 3 |
| Grow crops that require more or less water | 2 | 1 | 6 | 6 | 8 | 3 |
| Cultivate part of the land and leave part to fallow | 28 | 20 | 25 | 24 | 53 | 21 |
| Leave all the land to fallow | 0 | 0 | 2 | 2 | 2 | 1 |
| No change, continued the same way of farming | 2 | 1 | 4 | 4 | 6 | 2 |
| Others Responses to changing rainfall pattern | 2 | 1 | 1 | 1 | 3 | 1 |
| Total Count | 142 | | 106 | | 248 | |

Source: Survay data (2016)



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To address the specific objective that sought to identify the coping and adaptation strategies used by each gender, gender-based analysis of the application of adaptation strategies by cassava farmers was done. According to Aguilar, Araujo & Quesada-Aguilar (2007), climate variation does not affect women and men in the same way, as such gender-based impact arises. Therefore, all aspects related to climate variation (that is, mitigation, adaptation, policy development, decision making) must include a gender perspective.

A gender analysis of the responses shows that, 88% males and 86% females used adjustment in the planting date as response mechanism to climate variation. The fact was that almost the same number of males' and females adopted that strategy to cope with the changing rainfall pattern.

With regard to using different cassava varieties as a strategy, more women (63%) than men (55%) adopted it. More than ten varieties were cultivated (Table 31). These varieties are perceived by respondents to have certain qualities that made them suitable for cultivation under stressful climatic conditions. Some of the reasons the farmers gave for the preference of certain varieties were; a) the ability to give optimal yield under harsh climatic conditions; b) able to preserve for long; c) high starch content; d) good for fufu making, and f) good market price. Other reasons included; drought resistant, heat tolerance and early maturing (Table 30).

The most common reason for preference of a variety was good market price. Two hundred and ninety (290) respondents based their preference on this reason. The second most important reason for preference was the ability of the variety to preserve for longer period. Two hundred and fifty-nine (259) respondents indicated that their preference was based on that quality. The next



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important reason, was the ability to produce good yields under harsh climatic conditions. The least preferred quality was flood tolerant ability (Table 30).

**Table 30: Reasons why some cassava varieties are preferred over others**

| | Gender | | |
|---|---|---|---|
| Reason for preference (Multiple responses) | Male | Female | Total |
| Optimum Yield under harsh conditions | 154 (13%) | 99 (12%) | 253 |
| Able to preserve for Longer Period | 149 (13%) | 110 (13%) | 259 |
| High Starch Content | 122 (10%) | 72 (9%) | 194 |
| Good for Fufu | 137 (12%) | 113 (14%) | 250 |
| Good Market Price | 180 (15%) | 110 (13%) | 290 |
| Drought Tolerant | 148 (13%) | 101 (12%) | 249 |
| Heat Tolerant | 84 (7%) | 73 (9%) | 157 |
| Flood Tolerant | 52 (4%) | 39 (5%) | 91 |
| Early Maturing | 136 (125) | 103 (13%) | 239 |

Source: Survey data (2016).

Multiple responses

Table 31 shows the varieties of cassava cultivated in the study areas. It also shows the gender dimensions of the varieties cultivated. The most common varieties cultivated are the afisiafi, bosom nsia, CSIR-CRI sika bankye, madumaku, nyakumasi, the CSIR-CRI buroni bankye, bankye hemaa, the CSIR-CRI anpong and the CSIR-CRI otuhia. The afisiafi was the most widely grown variety. Nearly 48% of the farmers cultivated this variety. This variety was preferred by farmers because it was perceived to possess the following qualities; produce optimum yield under hash climatic conditions, able to preserve for longer periods, drought and heat tolerant and has high starch content (see Table 32). The second most cultivated variety was bosom nsia



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which was also cultivated by about 24% of the respondents. It was considered to be early maturing (see Table 32). Each of the other varieties was cultivated by less than 16% of the respondents.

On the whole, improved cassava varieties were not performing well in terms of adoption by farmers, despite their climate resilience potentials. According to the evidence available, the improved varieties were resilient or tolerant to climate variation (WAAPP, 2010). This, notwithstanding, it is evident from Table 31 that the farmers cultivated more of the older varieties such as the afisiafi and the busom insia than the recently released improved types. The probable reason could be that, because improved varieties were still new in the system, they are not yet known to the consuming public hence have low market value. For this reason the farmers concentrated on the old varieties which were widely preferred by consumers.

In terms of gender, afisiafi was equally cultivated by the two gender groups, (48% of males and 48% females). Bosom nsia was however cultivated by 26% males and 21% females. From Table 31, it can be observed that, more female farmers cultivated improved cassava varieties such as the CSIR-CRI buroni bankye, the CSIR-CRI sika bankye and the CSIR-CRI otuhia than the male farmers. For instance, the CSIR-sika bankye and the otuhia were respectively cultivated by 25% and 7% of the female respondents, compared to 16% and 4% by the male counterpart; 17% of the female respondents also cultivated the CSIR-CRI buroni bankye as against 10% of the male respondents.



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**Table 31: Cassava varieties cultivated by respondents**

| | | Multiple Responses | | | |
|---|---|---|---|---|---|
| Varieties | Male | % Male | Female | % Female | Total |
| CSIR-CRI Anpong | 14 | 10% | 14 | 13% | 28 |
| CSIR-CRI Buroni Bankye | 14 | 10% | 18 | 17% | 32 |
| CSIR-CRI Sika Bankye | 23 | 16% | 27 | 25% | 50 |
| CSIR-CRI Otuhia | 6 | 4% | 7 | 7% | 13 |
| Afisiafi | 69 | 48% | 51 | 48% | 120 |
| Bosom nsia | 38 | 26% | 22 | 21% | 60 |
| Madumaku | 29 | 20% | 18 | 17% | 47 |
| Nyakumasi | 23 | 16% | 23 | 21% | 46 |
| Esi Abeyem | 14 | 10% | 8 | 7% | 22 |
| Bankyee Hemaa | 25 | 17% | 6 | 6% | 31 |
| Sub-Total | 255 | 176% | 194 | 181% | 499 |
| **Some of the other Varieties used** | | | | | |
| Agege | 14 | 10% | 8 | 7% | 22 |
| Anoful | 18 | 12% | 8 | 7% | 26 |
| Okortor | 13 | 9% | 6 | 6% | 19 |
| Total | 300 | 207% | 216 | 202% | 516 |

Source: Survey data (2016).



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From a gender viewpoint, more males preferred new or old varieties because they attracted good market price, produce good yields under harsh climatic conditions, and were able to preserve for longer periods as against the female counterpart who were more interested in varieties that were drought tolerant in addition to high fufu making qualities. A good number of the females however preferred some of the varieties because of their high market value and the ability to store for longer periods (Figure 33). For example a male respondents who preferred nyakumasi over the other varieties had this to say:

> *"This variety produces tubers which can harvested within six months of planting and during this period there is scarcity of cassava in the market so it attacks high market price and if you are lucky you get over GHs9000/ha."*

This view was held by some of the other male farmers. On the other hand majority of the females indicated that;

> *nyakumasi has very high fufu qualities and it is also early maturing hence they are able to harvest it early enough for domestic consumption and in addition, process it into gari which attract very good market prices at the beginning of the farming season.*



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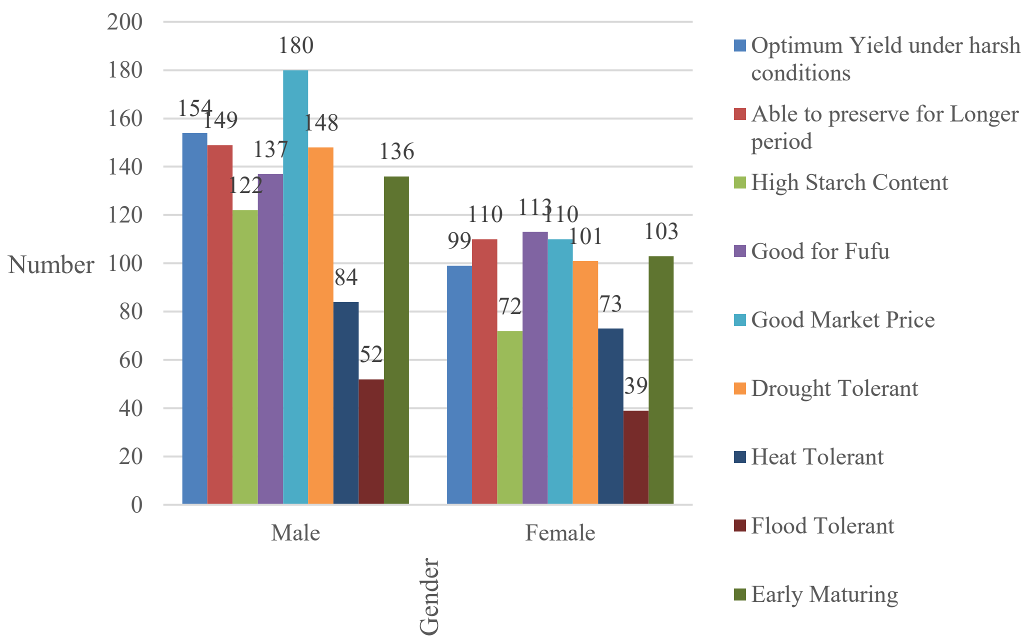


*Figure 33*: Gender representation of reasons for preference of a cassava variety

Source: Survey data (2016).

With regard to preference for individual varieties based on specific characteristics, the afisiafi cassava which was the most cultivated variety (Table 31), was preferred by the majority of the farmers (39%), because of its ability to produce maximum yields under harsh climatic conditions, ability to preserve for longer periods (31%), high starch content (44%), drought tolerance (37%), heat tolerant (35%) and flood tolerance (63%). The next most preferred variety with regard to its ability to produce good yields under harsh climatic conditions was the madumaku (16%). The CSIR-CRI buroni bankye was considered as not being climate resilient. Nyakumasi was the next after afisiafi in terms of preference based on longer preservation characteristic (14%), while madumaku was the next most preferred variety (after afisiafi) because of its high starch content (15%). Bosom esia, the next most cultivated variety was preferred by



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the majority of the respondents (22%) because of its early maturing characteristic. The CSIR-CRI sika bankye, the third most cultivated variety was preferred by majority of both male and female respondents because it is heat and flood tolerant. Another variety which was largely preferred by the respondents was the nyakumasi. It was preferred because of its good fufu making quality and high market value. Varieties that were grown because of their ability to withstand harsh climatic conditions such as drought, eratic rainfall, heat and flood and also mature early apart from afisiafi and bosom esia, included the madumaku and nyakumasi (drought tolerant), the nyakumasi (heat tolerant), the CSIR-CRI broni bankye and the nyakumasi (flood tolerant) and the nyakumasi and afisiafi (early maturing).

In terms of gender representation, 40% of the male respondents compared with 36% of the female preferred the afisiafi due to its ability to produce maximum yields under hash climatic conditions; 31% of the males and 32% of the females preferred it because of its ability to preserve for longer periods while 43% of the male respondents and 44% of the female respondents preferred it because of its high starch content. Furthermore, 67% males and 56% female preferred the afisiafi variety due to its ability to do well under flood conditions while 41% males and to 32% females cultivated it because it is drought resistant.

The boson nsia was liked by 23% males as compared to 20% females' due to its ability to mature earlier than the other varieties. Other improved varieties such as the CSIR-CRI-ampong, CSIR-CRI-otuhia, the CSIR-CRI-sika bankye and the CSIR-CRI-bankye hemaa were less cultivated. On the other



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hand, the CSIR-CRI sika bankye which was the next most preferred variety after the afisiafi, in terms of drought tolerance, was widely cultivated (Table 32).

The findings showed that the males preferred the varieties that could sell, were fast maturing and able to produce optimum yields under hash climatic conditions because of their market value. The females though preferred their market value, they also thought of the home - how good they are for food production. This confirms Patt, Dazé, and Suarez (2009) findings that women roles as caregivers and mothers meant that they always put the family first. The findings also supports that of Mary & Joelle (2009) that indicate that women are responsible for feeding the family and thus prefer to grow crops for the household .



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**Table 32: Gender disaggregated preference of cassava varieties**

| | Optimum Yield under harsh conditions | | | Able to Store for Long | | | High Starch Content | | | Good for Fufu | | | Good Market Price | | | Drought Tolerant | | | Heat Tolerant | | | Flood Tolerant | | | Early Maturing | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M | F | Total | M | F | Total | M | F | Total | M | F | Total | M | F | Total | M | F | Total | M | F | Total | M | F | | M | F | Total |
| CSIR-CRI Anpong | 2% | 5% | **3%** | 1% | 3% | **2%** | 2% | 11% | **6%** | 0% | 0% | **0%** | 1% | 2% | **1%** | 3% | 9% | **5%** | 6% | 7% | **6%** | 4% | 3% | **3%** | 1% | 0% | **0%** |
| CSIR-CRI Buroni Bankye | 1% | 1% | **1%** | 0% | 0% | **0%** | 2% | 3% | **2%** | 3% | 5% | **4%** | 2% | 5% | **3%** | 1% | 1% | **1%** | 5% | 7% | **6%** | 2% | 8% | **4%** | 1% | 2% | **1%** |
| CSIR-CRI Sika Bankye | 5% | 7% | **6%** | 5% | 6% | **5%** | 11% | 13% | **11%** | 7% | 12% | **9%** | 7% | 7% | **7%** | 5% | 6% | **6%** | 12% | 16% | **14%** | 15% | 21% | **18%** | 7% | 9% | **8%** |
| CSIR-CRI Otuhia | 0% | 1% | **0%** | 1% | 2% | **1%** | 0% | 1% | **1%** | 0% | 0% | **0%** | 0% | 2% | **1%** | 0% | 1% | **0%** | 1% | 1% | **1%** | 0% | 0% | **0%** | 0% | 1% | **0%** |
| Afisiafi | 40% | 36% | **39%** | 31% | 32% | **31%** | 43% | 44% | **44%** | 11% | 8% | **10%** | 11% | 16% | **13%** | 41% | 32% | **37%** | 40% | 29% | **35%** | 67% | 56% | **63%** | 14% | 16% | **15%** |
| Bosom Esia | 0% | 1% | **0%** | 5% | 5% | **5%** | 0% | 3% | **1%** | 23% | 16% | **20%** | 14% | 11% | **13%** | 1% | 2% | **1%** | 0% | 1% | **1%** | 0% | 5% | **2%** | 23% | 20% | **22%** |
| Madumaku | 16% | 16% | **16%** | 10% | 10% | **10%** | 21% | 6% | **15%** | 3% | 0% | **2%** | 13% | 15% | **14%** | 14% | 17% | **15%** | 17% | 16% | **17%** | 4% | 3% | **3%** | 10% | 12% | **10%** |
| Nyakumasi | 9% | 9% | **9%** | 13% | 15% | **14%** | 3% | 6% | **4%** | 23% | 22% | **22%** | 17% | 20% | **18%** | 7% | 10% | **8%** | 5% | 5% | **5%** | 0% | 0% | **0%** | 18% | 19% | **19%** |
| Kwei | 5% | 7% | **6%** | 7% | 8% | **7%** | 9% | 7% | **0%** | 8% | 16% | **12%** | 6% | 9% | **7%** | 5% | 4% | **5%** | 10% | 8% | **9%** | 6% | 3% | **4%** | 4% | 9% | **6%** |
| Bankyee Hemaa | 8% | 4% | **7%** | 9% | 5% | **7%** | 2% | 1% | **2%** | 10% | 4% | **7%** | 8% | 0% | **5%** | 8% | 3% | **6%** | 1% | 0% | **1%** | 0% | 0% | **0%** | 7% | 2% | **5%** |
| Other Varieties | 16% | 17% | **13%** | 20% | 17% | **17%** | 8% | 17% | **14%** | 13% | 17% | **15%** | 21% | 14% | **18%** | 18% | 25% | **16%** | 10% | 15% | **6%** | 6% | 5% | **2%** | 15% | 11% | **13%** |
| | 100% | 100% | **100%** | 100% | 100% | **100%** | 100% | 100% | **100%** | 100% | 100% | **100%** | 100% | 100% | **100%** | 100% | 100% | **100%** | 100% | 100% | **100%** | 100% | 100% | **100%** | 100% | 100% | **100%** |



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With regards to bush fallowing as an adaptation strategy the women were the major users (Table 29).

**Coping Strategies Under Unfavourable Weather Conditions**

When the weather was very unfavourable for cropping, respondents either left the farm to other places in search of temporary jobs, for wage labour, or engaged in other jobs such as petty trading, corn mill operation, fishing, palm oil extraction, selling firewood, and animal rearing. Others took loans and invested in non-farming businesses, while some waited for the rains to start. For example, about 61% of the respondents (Table 33) engaged in jobs other than farming; the 61% comprised 55.2% males and 69.1% female respondents. The females usually engaged themselves in petty trading, firewood selling, and hair dressing, while the males went into commercial vehicle driving, corn-mill operation, fishing, and masonry. With regard to wage labour, the majority (37%) who were males usually engaged themselves in road construction, while the women (15.9%) were engaged in oil palm extraction. A group discussion with the males revealed that;

> *during periods of extreme droughts when farming was impossible, waged labour such as road construction and commercial vehicle driving were more profitable to engage in but these jobs are usually found in the urban and peri-urban areas. Since they are the bread winners, they are compelled to move out of their communities in search of these jobs where they existed so that they can send remittances to their families at home. As for the female famers, they have stay back because they will*



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*have to take care of the children hence they engage in other non-farming business such as firewood selling or petty trading available in their communities or surrounding communities.*

**Table 33: Other gender adaptations strategies under extreme climatic conditions**

| | | | What do you do in years of unfavourable weathers? | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | | | N/R | Migrate | Go for waged labour other than farming | Take a loan to invest into other non-farming business | Other Means | |
| Sex | Male | Count | 3 | 18 | 41 | 3 | 80 | 145 |
| | | % within Sex | 2.1 | 12.4 | 28.3 | 2.1 | 55.2 | 100 |
| | Female | Count | 4 | 3 | 17 | 5 | 78 | 107 |
| | | % within Sex | 3.7 | 2.8 | 15.9 | 4.7 | 73.0 | 100 |
| Total | | Count | 7 | 21 | 58 | 8 | 158 | 252 |
| | | % of Total | 2.8 | 8.3 | 23.0 | 3.2 | 62.7 | 100 |

Source: Survey data (2016)
N/R =Non-Response

**Other Gender-Based Adaptation Strategies used by Farmers**

Figure 34 presents some more strategies respondents frequently employed to cope with anticipated impacts of the seasonal variation in rainfall from gender perspective. According to the results, there existed clear gender disparities in the preference of the adaptations strategies. For example, more males (25%) used early maturing cassava varieties as an adaptation strategy. It was also the majority of male (33%) who changed their planting data to coincide with the onset of rains. On the other hand, the females were in the majority in terms of intercropping, fertilizer usage, use of drought tolerant varieties and



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diversification into non-farming businesses. According to the male farmers through a focus group discussion on the adaptation strategies used to combat the effect of climate variation:

> *Early maturing cassava varieties gave very good yields within six months of planting instead of the normal 8-12 month required for cassava maturity. This provided very good market prices at the time of harvest. They indicated that with just 3 months of rains they are sure of good harvest.*

With regard to the changing of planting dates they said that*;*

> *it was very easy to do since they usually pick up information about the climate from agro-based radio discussions and from AEAs coupled with their own experienced gathered over the years from farming cassava.*

Another group discussion with the females revealed that the application of fertilizer helped them to increase their yields. They indicated that:

> *Majority of them own one farmlands which are smaller in size due to limited access to land hence in order to maximize yields they needed apply a lot of fertilizer. According to them women are not supposed to have big farms since commercial farming was the responsibility of their husbands. They further indicated that the drought tolerant varieties were introduced to them by MoFA AEAs and upon trial they realized that the yields were encouraging even in the early stages of the dry season. Hence they were able to get good harvests on their limited lands and*



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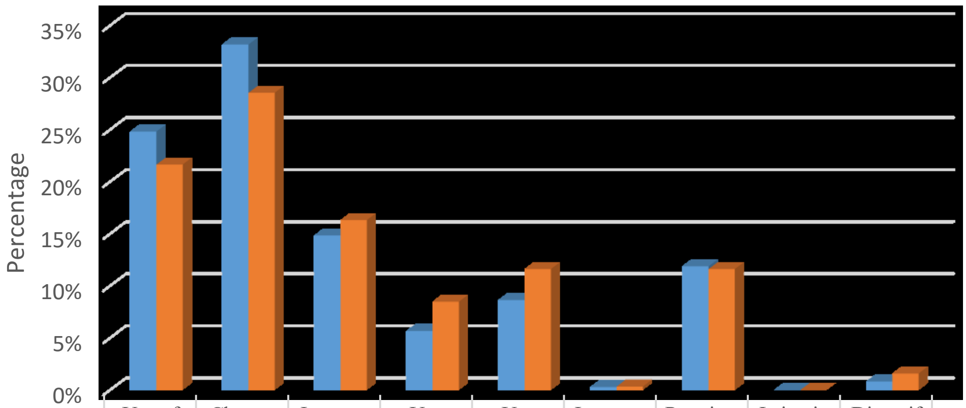
*that is what motivated them to adopt these varieties. The changing of planting dates was something they do when they realise that the rainfall pattern was not "normal" during the early stages of the onset of the raining season.*

Thus, apart from the use of early maturing varieties and changing of the planting dates, the females were the majority users of all the other strategies. These findings are in line with Patt et al. (2009) who argues that different gender attitudes in risk responses exist.




| | Use of early maturing cassava varieties | Change plantting period | Intercrop cassava with other crops | Use fertilizer | Use drought tollerant cassava varieties | Increase farm size | Practice mixed farming | Irrigation | Diversify into non-farming business ventures |
|---|---|---|---|---|---|---|---|---|---|
| Male | 25% | 33% | 15% | 6% | 9% | 0% | 12% | 0% | 1% |
| Female | 22% | 29% | 16% | 8% | 12% | 0% | 12% | 0% | 2% |

Figure 34: Adaptation strategies used by male and female farmers to cope with the effects of changes in seasonal variations in rainfall

Source: Survey data (2016)

Within Gender Analysis

N/R = No Response

To test the null hypothesis which said there are no gender differences in the adaptations to climate variations by cassava farmers, a contingency test was carried out on some of the widely used adaptation strategies by farmers (Bush



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fallowing, changing planting dates, intercropping, use of drought tolerant and fertilizer application). Results of both the chi-square test and symmetric measures (Tables 35, 36 and 37) returned significant values less than 0.05 for fertilizer use, the use of drought tolerant varieties and bush fallowing,. The fact was that the use of fertilizer, the adoption of drought tolerant varieties and bush fallowing, as response measures to the effects of seasonal variations, were all not gender neutral. The implication is that since fertilizer application, use of drought tolerant varieties and bush fallowing are gender dependent, we reject the null hypothesis conclude there are gender dimension in the adaptations strategies used by cassava farmers in the Awutu Senya district because these three are types of adaptation to climate variation.

**Table 34: Cross-tabulation of gender-based use of fertilizer and drought tolerant varieties**

| | | | Use fertilizer | | | | | | Use of drought tolerant varieties | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Yes | No | Total | | | | Yes | No | |
| Gender | Male | Count | 21 | 124 | 145 | Gender | Male | Count | 32 | 113 | 145 |
| | | % within Sex | 14.5% | 85.5% | 100 | | | % within Sex | 22.1% | 77.9% | 100% |
| | Female | Count | 27 | 80 | 107 | | Female | Count | 37 | 70 | 107 |
| | | % within Sex | 25.2% | 74.8% | 100 | | | % within Sex | 34.6% | 65.4% | 100% |
| Total | | Count | 48 | 204 | 252 | Total | | Count | 69 | 183 | 252 |
| | | % within Sex | 19.0% | 81.0% | 100 | | | % within Sex | 27.4% | 72.6% | 100% |

Source: Field data (2016)



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**Table 35: Chi-square test: gender and fertilizer use, gender and the use of drought tolerant varieties**

Chi-Square Tests

| | Gender and Fertilizer use | | | | | Gender and use of drought tolerant variety | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Value | Degrees of Free-dom | Asymp. Sig. (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) | Value | Degrees of Free-dom | Asymp. Sig. (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
| Pearson Chi-Square | 4.615[a] | 1 | .032 | | | 4.846[a] | 1 | .028 | | |
| Continuity Correction | 3.944 | 1 | .047 | | | 4.237 | 1 | .040 | | |
| Likelihood Ratio | 4.565 | 1 | .033 | | | 4.809 | 1 | .028 | | |
| Fisher's Exact Test | | | | .036 | .024 | | | | .032 | .020 |
| Linear-by-Linear Association | 4.597 | 1 | .032 | | | 4.827 | 1 | .028 | | |
| N of Valid Cases | 252 | | | | | 252 | | | | |

Source: Field data (2016)



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**Table 36: Symmetric measure for association: gender and fertilizer use, gender and the use of drought tolerant varieties**

Symmetric Measures

| Gender and Fertilizer use | | | | Gender and use of drought tolerant variety | | | |
|---|---|---|---|---|---|---|---|
| | | Value | Approx. Sig. | | | Value | Approx. Sig. |
| Nominal by Nominal | Phi | .135 | .032 | Nominal by Nominal | Phi | .139 | .028 |
| | Cramer's V | .135 | .032 | | Cramer's V | .139 | .028 |
| | Contingency Coefficient | .134 | .032 | | Contingency Coefficient | .137 | .028 |
| N of Valid Cases | | 252 | | N of Valid Cases | | 252 | |

Source: Field data (2016)

**Table 37: Chi-Square tests: gender and bush fallowing**

| | Value | df | Asymp. Sig. (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|---|---|---|---|---|---|
| Pearson Chi-Square | 8.000[d] | 1 | .005 | | |
| Continuity Correction | 4.302 | 1 | .038 | | |
| Likelihood Ratio | 10.585 | 1 | .001 | | |
| Fisher's Exact Test | | | | .018 | .018 |
| Linear-by-Linear Association | 7.000 | 1 | .008 | | |
| N of Valid Cases | 8 | | | | |

Source: Field data (2016)

It is observed from the findings that extended drought, erratic rainfall, increasing temperatures, and decreasing rains adversely affected both male and female cassava farmers in the study communities. The effects forced farmers to adapt to certain strategies among which were the use of early maturing cassava varieties, changing planting dates, intercropping cassava with other crops, the application of fertilizer, and the use of drought tolerant cassava varieties. This



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is corroborated by the findings of FAO (2007) that reveal that farmers continuously adapt to climate variation at the local level by changing crops or varieties, choose different harvest and sowing dates, alter land management and employ water efficiency techniques. Other adaptations included, increasing farm size, bush fallowing, and engaging in non-farming business ventures.

The re-scheduling of planting dates, delay harvesting of cassava and food rationing were some of the indigenous or traditional practices employed by the farmers as coping strategies. The results indicated that, farmers waited for the changes in the weather to start the planting and harvesting of their crops. The application of indigenous knowledge to mitigate the impacts of climate variation are consistent with those from other studies by Gyampoh, Amisah, Idinoba, and Nkem, (2009); Orlove *et al.*, (2010); Speranza, Kiteme, Ambenje, Wiesmann, and Makali, (2010). For example, Orlove *et al.* (2010) observed that farmers in southern Uganda use indigenous astronomical knowledge such as the changing phases of the moon as indicators of impending rainfall to plan their agricultural operations.

The findings relating to gender dimensions in the application of climate variation coping or adaptation strategies are in line with Antwi-Agyei (2012) and Patt et al (2009). For example, Antwi-Agyei (2012) identified significant gender influence in the use of agro-forestry and indigenous knowledge as adaptation strategies. Patt et al. (2009) also observed different gender attitudes in risk responses to climate variation.

According to the findings from the present study, more females than males use more adaptation strategies. However, the relationship between gender



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and the choice of adaptation was only significant in the fertilizer application, the use of drought tolerant varieties and bush fallowing.

The findings therefore suggest that although gender parity with regard to the adoption of the identified adaptation strategies among the farmers is necessary, more efforts should be devoted in ensuring gender parity in fertilizer application and the use of drought tolerant cassava varieties. This is because these two adaptation strategies have been identified as some of the most effective climate-smart strategies for overcoming the adverse effect of climate variation (WAAPP, 2014 and MoFA, 2014). Hence gender parity in the adaption of these adaptation strategies could have a positive impact on cassava production in the face of climate variation since there is a direct relationship between them and gender. Bush fallowing is not convenient due to increasing pressure on land for residential and industrial purposes. The best alternative for this method of adaptation is fertilizer application which is even more superior in terms of results, because new technologies for location and crop specific fertilizers have evolved with the appropriate application protocols (WAAPP, 2014).

Farmers admitted using certain non-agricultural strategies to adapt to climate variation, especially in extreme cases of droughts, where farming became near-impossible. The findings indicate that, majority of male respondents usually went to engage in construction work, commercial vehicle driving, corn mill operation, and loans for investments, while the females frequently engaged themselves in hairdressing and firewood collection for sale. These livelihood diversification as a coping and adaptation strategies



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corroborate other studies (Ellis, 1998; Barrett *et al.*, 2001; Paavola, 2008) that suggest that households may pursue non-farm activities as a way of averting the risks associated with crop failure due to erratic rainfall patterns.

**Gender and Institutional Support for Climate Variation**

The capacity to adapt to the changing climatic conditions is said to depend on the availability and access to the appropriate climate smart information and resources (FAO, 2015; Limantol, Keith, Azabre and Lennartz, (2016). According to Agrawal & Perrin (2008) institutions play a crucial role in shaping adaptation to climate variation, and because adaptation to climate variation would need to occur locally, it is critically important to understand the role local institutions play in adaptation to climate variation, if adaptation is to help the most vulnerable social group. Maddison (2007) and Smit and Pilifosova (2003) also state that institutional interventions are necessary for successful adaptation. In view of these earlier findings, farmers were asked to indicate whether they had ever received any climate smart agricultural information or support from any government agencies. They were also asked to indicate the form of support they obtained and from which government agencies.

According to the responses (Table 38), 65.9% of all the farmers indicated that they received some form of support from several agencies; however, 71% male respondents, and 59% females got support from agencies.



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**Table 38: Indication of farmers ever receiving support from agencies**

| | | Ever received support from agencies | | | | | |
|---|---|---|---|---|---|---|---|
| | | N/R | Yes | % Yes | No | Don't Know | Total |
| Gender | Male | 1 | 103 | 71% | 37 | 4 | 145 |
| | Female | 1 | 63 | 59% | 38 | 5 | 107 |
| Totals | Total | 2 | 166 | 65.9% | 75 | 9 | 252 |
| | % Total | 0.8% | 65.9% | | 29.8% | 3.6% | 100.0% |

With regard to the information received, respondents indicated various types of information. Figure shows the types of information farmers indicated the received from the various agencies. According to Table 39 Some 26% indicated that they received services from Agricultural Extension Assistants (AEAs) in the form of climate smart agricultural practices and 24% received fertilizer subsides. Another 21% got information about good agricultural practices while 28% received various supports including certified improved seeds (17%), information on climate change and adaptation (10%) and loans or credits (1%) from MoFA, GMet, and GIDA.

Mackay, Kenny and Chappell (2010) said that there is need for institutionalising gender in all levels of decision-making processes. These include both government and private agencies facilitating adaptation to climate variation. The results from gender perspective are that, male farmers were mostly accessing support in the form of fertilizer subsidies, services from MoFA-AEAs, and loans or credits from Banks, while female farmers sourced support in the form of information regarding good agricultural practices, certified improved seeds and information on climate change and adaptation from MoFA-AEAs (See Table 39).



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**Table 39: Gender differences in the type of support obtained from government agencies**

| Type of Information Sought | Within % Total | Within % Male | Within % Female |
|---|---|---|---|
| Information regarding agricultural practices | 21% | 20% | 23% |
| Fertilizer subsidies | 24% | 27% | 21% |
| Certified improved seeds | 17% | 17% | 18% |
| Information on climate change and adaptation | 10% | 8% | 12% |
| Support from AEAs | 26% | 27% | 24% |
| Loans or credits | 1% | 2% | 1% |

Source: Field data (2016)

Within gender analysis

With regard to institutions from where support was obtained (Table 40), the Ministry of Food and Agriculture (MoFA) was the main source of information. Forty-four percent (44%) of respondents obtained support from this agency. Other important institutions were the Ghana Health Services (13%), District Assemblies (11%), the Ghana Meteorological Agency (10%), the Ghana Irrigation Development Agency (10%), the Veterinary Service (9%), the Agricultural Development Bank (1%), and others sources (1%). These findings are in line with the findings of USAID & MFCS (2014), which indicate that government/public organisations primarily led by the MoFA were involved in helping the smallholder farmers in Ejura Sekyeredumansi address the climate variation challenge. The services that were provided by these institutions to help the farmers address climate variation ranged from technology transfer, education/information and training and credit provision.



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**Table 40: Support institutions and adaptation to climate variation**

| Agency | Male | % Male | Female | % Female | Total | % Total |
|---|---|---|---|---|---|---|
| MoFA | 102 | 46% | 67 | 40% | 169 | 44% |
| ADB | 3 | 1% | 1 | 1% | 4 | 1% |
| Meteorological service | 20 | 9% | 19 | 11% | 39 | 10% |
| GIDA | 17 | 8% | 20 | 12% | 37 | 10% |
| Ministry of Fisheries | 5 | 2% | 2 | 1% | 7 | 2% |
| Veterinary Service | 19 | 9% | 14 | 8% | 33 | 9% |
| Ghana Health Services | 26 | 12% | 24 | 14% | 50 | 13% |
| District Assemblies | 26 | 12% | 16 | 10% | 42 | 11% |
| **Other sources of support** | **Male** | **%Male** | **Female** | **%Female** | **Total** | **%Total** |
| Awutu Emasa Rural Bank | 2 | 1% | 0 | 0% | 2 | 1% |
| Church | 0 | 0% | 1 | 1% | 1 | 0% |
| Local Banks | 0 | 0% | 1 | 1% | 1 | 0% |
| Micro Finance Agencies | 0 | 0% | 1 | 1% | 1 | 0% |
| | 220 | 100% | 166 | 100% | 386 | 100% |

Source: Survey data (2016)

Within gender analysis

Respondents were asked to indicate the kind or type of support they thought they would need to help them adequately to deal with the stresses associated with seasonal variations in rainfall and temperature in order to improve on cassava production. A number of suggestions (Figure 35) were made, which included timely information, and good agricultural practices (12%), timely subsidies on fertilizer, seeds and other farming inputs (56%) and timely loans or credit (30%).



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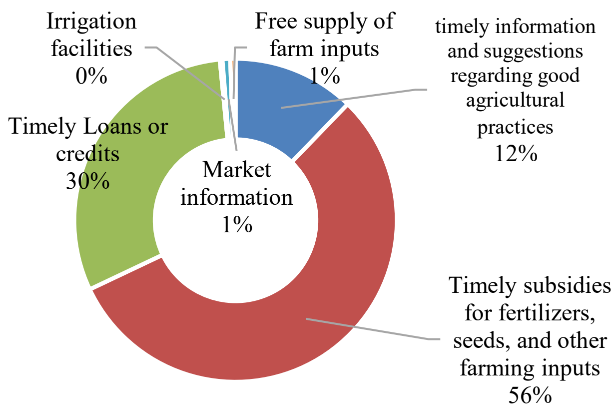


*Figure 35:* Farmers preferred climate variation adaptation support service

Source: Survey data (2016)

A gender analysis revealed that, males mostly preferred timely loans or credits while the females preferred timely subsidies on fertilizer, seeds and other farming inputs (Figure 36).

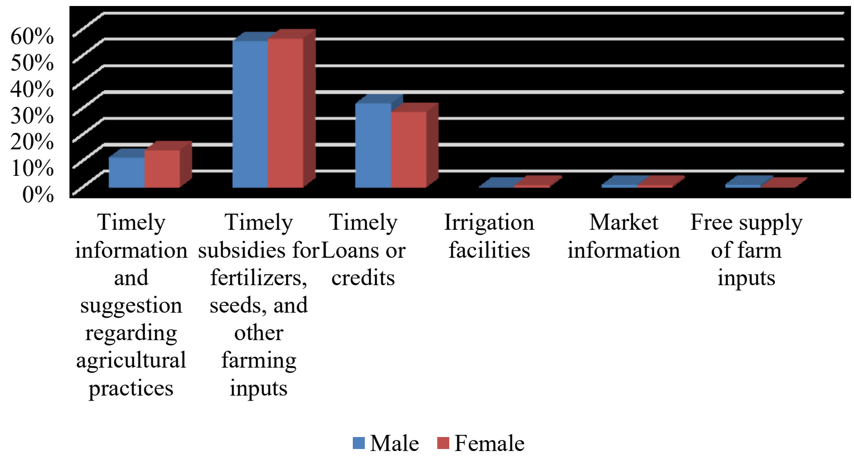


*Figure 36:* Gender and preference for adaptations strategy from support institutions

Source: Survey data (2016)
Within gender analysis

From the above, it is clear that the types of support the farmers requested for were gender oriented. For example, majority of the male respondents accessed support in the form of fertilizer subsidies, services from the AEAs, and



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loans or credits, while majority of the female farmers sourced for improved agricultural practices, certified improved seeds and for information on climate change and adaptations. This observation is in line with Pratt et al. (2009) who said that women are more likely than men to seek and listen to advise, and learn from others with more experience.

Most of the coping mechanisms used by the farmers were obtained from the climate smart agricultural support agencies. It was observed that although majority of male farmers frequently went for fertilizer subsidies, it was rather the female farmers who used fertilizer more as a response mechanism to climate variation. This contradiction could probably be due to the fact that some of the male recipients of the subsidy re-sold the fertilizers for higher prices in order to make some profit. That practice was reported by one of the MoFA officials in charge of the fertilizer subsidy programme. This observation is consistent with the observation of Pratt et al, (2009) that indicate difference in gender attitudes in risk responses to climate variation.

Some gaps in the delivery of climate variation adaptation support services were noted during the field work. For example, some of the respondents, especially the females, expressed their concern that, support services such as subsidies on fertilizer, seeds and other farming inputs were not always accessible to them. They further reported that, the time they needed the services, and the time the services were available never coincided. They also reported that the information on climate-smart agriculture was also not timely given. Consequently, the female respondents opined that most of the interventions should be made available and easily accessible to them and on



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time. The male respondents said that they needed loans or credit on time to enable them start business ventures for their wives to cushion them against severe climatic shocks.

The prevailing gender disparities in preference and access to gender-specific information and support services call for public and private climate-smart support service providers to employ gender-sensitive delivery approaches. Gender-based information or technologies should be disseminated through channels that are accessible for both men and women for rapid diffusion and adoption of by farmers. This may include the use of information communication technology strategies such as e-agriculture and e-extension services which provide vital agro-based and climate-smart information to farmers through mobile phones. In addition, the provision of climate-smart support services to farmers should take cognisance of the time of the season that they are most appropriate. There also is a need to synergize support services meant for the adaptation to climate variation by public and private climate-smart support service providers in order to avoid duplication of efforts.

## Summary

Extended drought, erratic rainfall, increasing temperatures, and decreasing rains have adversely affected both male and female cassava farmers in the study communities. Farmers have suffered directly and indirectly from the adverse effects of climate variation on cassava production.

Majority of males reported of decreasing crop yields, delayed harvesting and increased incidence of cassava root rots because they had larger and several



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plots of land, hence they were those who suffered the most from the adverse effects. Majority of females also reported crop losses, because of their poor financial base and low educational background. The findings indicated that, more of the females suffered indirect adverse effects such as reduced incomes and increased indebtedness. A situation that has been attributed largely to gender difference in the access to land. Goh, (2012), has opined that assets accumulation is very essential for tackling the adverse effects of climate variation. Hence equity in land resources distribution for both male and female is crucial for addressing climate variation effects. The results also suggested that majority of female farmers bore heavier burdens emanating from the consequences of climate variation because of the lack of support from their husbands.

The adverse effects of climate variation on cassava production have forced farmers to adapt to certain strategies such as the use of early maturing cassava varieties, changing planting dates, intercropping cassava with other crops, the application of fertilizer, and the use of drought tolerant cassava varieties. Other adaptations include, increasing farm size, bush fallowing, and engaging in non-farming business ventures. There were clear gender dimensions with regards to the use of the various adaptation strategies. This has been buttressed by the fact that more females than males use more adaptation strategies. Such finding have corroborated the observations of researchers like Patt et al. (2009) who observed that different gender attitudes towards risk responses to climate variation exists.



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Gender difference in the choice of adaptation was significant in the fertilizer application, the use of drought tolerant varieties and bush fallowing. These findings suggest that, gender sensitive effort is required to ensure gender balanced adoption of adaptation strategies among the farmers, especially the use of fertilizer and drought tolerant varieties. Farmers admitted using certain non-agricultural strategies to adapt to climate variation, especially in extreme cases of droughts, where farming became near-impossible. The observation on livelihood diversification as a coping and adaptation strategies corroborated other studies such as those by Ellis (1998); Barrett *et al.*, (2001) and Paavola (2008) that suggest that households may pursue non-farm activities as a way of averting the risks associated with crop failure due to erratic rainfall.

In order to effectively adapt, both male and female farmers identified some measures they would want to use to improve upon agricultural production and deal with climate variation impacts. These include the availability of timely climate smart information, easy access to climate smart information and loans or credit facilities.



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# CHAPTER SEVEN

# SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

## Introduction

This chapter presents the summary of the research. It also presents the conclusions and recommendations to address issues related to the challenges of climate variation in the study area and elsewhere in the country.

## Summary

Variation in rainfall and temperatures in Ghana are affecting production of cassava in Ghana. The production and processing of the crop is important in the Central Region, especially in the Awutu-Senya District, where men, women and the youth are actively engaged in. It is cultivated by over 90% of the farming population in the country of which about 41% are women and about 30% youth. Notwithstanding the large numbers of women engaged in cassava production, little or no study has been done on how male and female farmers (men, women, youth and aged) differently mitigate risks and adapt to challenges brought about by climate variation. It is on this premise that this research was undertaken.

The main objective of the study was to explore the gender-based adaptation strategies used by the cassava farmers in the Awutu Senya district to overcome the effects of climate variation on cassava production.

The study used the mixed method research approach to collect and analyse both quantitative and qualitative data. Structured questionnaires, in-depth interviews and focus group discussions were used to collect primary data, while document reviews, and electronic media were the sources of the secondary data. Processing and analysis of data was done using a combination



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of two statistical software; the IBM SPSS version 20, and the Microsoft excel 2013 edition. Chi-square tests and symmetric measures were used to determine if differences existed between gender groups (Male and female) with regard to vulnerability and adaptations to the effects of climate variation on cassava farmers. Results were presented in both descriptive and inferential statistics. Conclusions were then drawn based on the differences or similarities emerging from the analysis.

**Key Findings**

The following emerged as the major findings:

- Results showed that rainfall pattern was inconsistent and difficult to predict. Much of the 30-year period recorded rainfalls below the mean. The results also showed an increasing trend in the mean annual temperature.
- Male and female farmers perceived climate variation differently. Although both gender groups indicated noticing changes in the weather pattern, there were gender disparities in some of the observations. For example, majority of males noticed decreasing rainfall and increasing drought over the period. With regard to the causes of climate variation, there were some gender differences in the responses. Whilst some 7 out of every 10 of the male respondents associated climate change or variation with environmental degradation, only 5 out of every 10 female respondents associated climate change or variation with environmental degradation.
- Both male and female farmers had experienced direct and indirect effects of climate variation. The experiences included reductions of crop yields,



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delayed harvesting, reduced incomes, increased debts, and increased incidences of cassava rot and food shortages. Some differences existed between the males and females with regard to the type of effects suffered. The majority of those who suffered from food shortages, reduced incomes, and increased indebtedness were females, while more males suffered from decreased crop yields, delayed harvesting and increased incidences of cassava root rots.

- Vulnerability to climate variation was also observed along gender lines. Some of the vulnerability factors included whether one was male or female, limited level of education, limited or lack of access to land resources, inadequate access to timely weather and climate smart agriculture information, and lack of support from government agencies or spouse. The majority of respondents who were with low educational background, limited access to resources such as land, weather and climate smart agriculture information and inadequate support from government agencies or spouse were females. Other vulnerability factors included limited incomes, food shortages, low standards of living and indebtedness. In all these areas, the females were more disadvantaged than the males.
- There were some gender dimensions in the adaptation and coping strategies used. Females were the majority users of all the climate-smart agricultural practices such as early maturing cassava varieties, changing planting dates, intercropping cassava with other crops, fertilizer application and the use of drought tolerant cassava varieties. On the other hand, males were in the majority when it came to the use of non-agricultural adaptation strategies



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such as construction work, commercial vehicle driving, corn mill operation and the acquisition of loans for investments.

**Conclusions**

The findings of the study show a great sense of awareness of climate variation among respondents. Respondents' observations shows that both male and female farmers have similar or identical perceptions of temperature and rainfall trends over the past three decades. These perceptions also match well with the climatic records of the study area, which shows increases in drought conditions, erratic rainfall patterns, diminishing rains, increasing temperatures and the occurrence of dry spells during the past three decades. Despite the similarities in perceptions, the males were more accurate in their description of the climatic trends.

The probable reason why more female farmers perceived rainfall and temperature differently could be that their perceptions were affected by factors such as education and their experiences as farmers. Finding from Chapter 5 for example, indicate that, majority of female farmers were without formal education, or had very limited formal education. The findings also indicate that, majority of farmers in the youthful age category are females. These are factors that were likely to affect one's interpretations and conclusions of climatic trends such as rainfall and temperature patterns over time (Mamba, 2016). It thus stands to suggest that because females were more disadvantage in terms of their low levels of formal education and less experience in farming, they were not able to recognise that the rainy seasons were decreasing and that the drought



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periods were increasing.

With regard to perception about the causes of climate variation, again majority of males perceived climate variation to be associated with land degradation. A handful of respondents, majority of who were females, believed that variation was a curse from God. These differences in perception could also be due to the fact that there were more educated and elderly and hence experience male farmers in the study community than females.

Although both male and female farmers suffered from adverse effects of climate variation, the two genders suffered different impacts. Adverse effects were felt more by the men with respect to decreasing cassava yields, delayed harvesting due to extended drought, late planting and increased incidence of cassava root-rot. The males suffered more from decreasing yields probably because the majority did not adopt improved cassava production practices or climate smart technologies. Females on the other hand suffered more from crop losses and low or reduced incomes probably because they had less access to land, hence were majority owners of single farmlands of smaller sizes.

The women were affected more by the negative impacts of climate variation because females suffered more from reduced incomes and increased indebtedness. These could affect one's ability to make ends meet.

Evidence from the present study points to the fact that the female gender is the more vulnerable to climate variation. This is because in addition to the majority of women having less access to land resources; low educational background, limited access to credible weather information and support services from agencies, most of them source weather information from



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neighbors and family members, while others rely on traditional knowledge to predict the weather thereby exposing them to greater climatic risks, and minimizing their adaptive capabilities simply because of illiteracy. Another factor that probably contributed to the high vulnerability of the female farmers is their spouses playing the dominant role in determining what crop should be cultivated, and what actions should be to taken during extreme weather conditions, in spite of the wives ingenious knowledge of addressing the challenges.

One important factor with a higher tendency of reducing a farmer's vulnerability to the adverse effects of climate variation identified is the support received from spouses. The support took various forms such as help on the farm, financial support with proceeds from non-farming business or advice. Respondents who received support from their spouses indicated that they were able to overcome to a greater extent, the challenges from climate variation because of their spouse interventions. Majority of the beneficiaries of this kind of support were males. Hence the male farmers were able to cope well with the adverse effects of climate variation than their female counterparts.

In the case of gender adaptation to the impact of climate variation, the empirical data has revealed that both male and female farmers were employing complementary methods in response to the unstable weather conditions in order to enhance cassava production. Farmers employed on-farm adaptation strategies such as changing the timing of planting, planting drought-tolerant crops and early maturing cassava varieties, increasing farm size, practicing mixed farming and the application of fertilizer. Although these strategies were employed by



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both male and female farmers the majority of the female farmers adopted more of the coping strategies.

In terms of the application of the adaptation strategies from gender perspective, it was observed that, more males resorted to waged labour or the acquisition of loans for investment, while the majority of females resorted to firewood gathering, petty trading and hairdressing as alternative source of incomes in events of extreme weather conditions. The varying degree of application of the various adaptation or coping strategies by each of the two gender groups emphasise the strong gender dimensions in the adaptation strategies used by farmers in the study area.

As farmers could not rely entirely on their own traditional methods for surviving the challenges brought by the changing climatic condition, they relied on the information and support services offered by agencies such MoFA, Ghana Health Services, District Assemblies, Meteorological Service, GIDA, Veterinary Service and the Agricultural Development Bank. The agency mostly utilised was the MoFA. Both male and female farmers obtained information on good agricultural practices that ensured improved yields even under stressful climatic conditions. They also relied on the MoFA to receive information on climate-smart agricultural innovations such as drought tolerant and early maturing cassava varieties and subsidised fertilizer to help improve yields of cassava under both stressful and unfavorable climatic condition. The AEAs from the MoFA provided advice to farmers on what to do when faced with situations such as drought and irregular rainfall. Although almost all the respondents agreed that the assistance and support from the agencies were very



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helpful, they opined that most of the support services provided were usually inadequate and came in late. For example, they pointed out that the climate resilient cassava varieties and fertilizer subsidy each farmer received were inadequate and usually received late in the farming season thereby rendering their applications ineffective.

It was observed that most of the institutional support services accessed by farmers were gender biased because more males obtained invaluable support in the form of fertilizer subsidies, services from the AEAs and loans or credits from financial institutions. On the other hand, female farmers were able to source support only in the form of information regarding good agricultural practices, certified improved cassava planting materials and information on how to effectively adapt to unstable climatic conditions.

With regard to the acquisition and usage of intuitional support services by each gender group some differences were noticed. Whereas the male farmers went for subsidised fertilizers, the female farmers applied the fertilizers on their farms. The men sold the subsidised fertilizer at higher prices to the women farmers in order to make profit instead of applying them on their farms.

Knowledge on the preferred support or assistance by each gender group can be useful in designing support services meant to improve agricultural productivity in the event of climate variation. With information on what is required by male and female farmers to address challenges of climate variation, agencies and research institutions can put together climate sensitive innovations or technologies and packages that could bring fairness in the enhancement of the adaptive capacities of both male and female. This will ensure that no one



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gender is disadvantaged with regard to climate variation.

## Recommendations

Based on the research objectives, questions and the findings, the following key recommendations are made:

i. Education and experience emerged as the important determinants of perception. It will therefore be very useful if development practitioners, policy makers, government agencies, donors and researchers pay much attention to bridge the knowledge and education gap between male and female farmers. This can be achieved through intensive training and sensitization of farmers. Farmers can be given lessons on weather and climate occurrences such as erratic rains, prolonged drought, increasing temperatures and shortening of rainfall periods. Such sensitization or training programmes should target the disadvantage group who are mainly the female farmers and other male farmers with particular disadvantages. Training and sensitization programmes can take the form of field-fora, field-schools, demonstrations, and trial fields.

ii. Climate variation adaptation programmes and contents should be integrated into electronic database platforms such as the e-agricultural platform which is used to disseminate agricultural information to farmers via mobile phones.

iii. Government should put in place policies that will deliberately target the education of the less educated, inexperienced and vulnerable farmers on climate change and variation, its causes and the best climate smart



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agricultural practices.

iv. The MoFA should collaborate with the Ghana Meteorological Agency to develop training programmes on early warning signs, simple weather reading kits and climate variation. This will help improve farmers' knowledge of climatic trends and how to respond to climate variation impacts when the signs are showing.

v. One of the key vulnerability factors of female farmers to climate variation is lack of access to land resources which is facilitated by some cultural and social norms existing in the study area. It is recommended that cultural practices leading to the acquisition of land should be reviewed to ensure equity in land acquisition. This is because cassava cultivation in the areas is done by a large number of females, hence it is only fair that land acquisition by both males and females for farming purpose should be made equally accessible. This can be achieved through consensus building involving local authorities, the District Assembly, traditional leaders and farmers (including leaders from both the male and female gender groups) where land issues are dispassionately discussed and agreements reached. Consensus should be based on reviewing rules, regulations and traditions that limit one's ability to access arable land because of gender.

vi. Another important vulnerability determinant is access to credible weather information. Here females are more disadvantaged. As such, it is essential to have a system of information that is equally accessible to all farmers without biases, due to gender. Access points and legitimate community information sources pertaining to weather and good agricultural practices



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should be created by the District Assembly and MoFA to ensure easy and free access to climate smart information. All farmers should be encouraged to patronize these dissemination platforms for credible information that will be beneficial to them. The ideal situation will be the case where information is tailored to the decision-making needs of farmers, and on time. To strengthen female farmers' access to credible weather information, they should be encouraged to join social groups such as Farmer Based Organizations and other women's organizations.

vii. In order to reduce crop losses and decreasing crop yields associated with climate variation, MoFA and other allied institutions should endeavor to make farmers aware of existing technologies and innovations that are capable of over-coming climate variation. Climate resilient cassava varieties such as the CSIR-Ampong, CSIR-Sika Bankye, CSIR-Otuhia, *Busom Nsia* and *Esam Banlye* should be made available to farmers. Farmers should be taught the advantages of planting them to dispel their fears. Intensive dissemination efforts should be made by the MoFA to reach as many male and females with climate resilient cassava varieties together with other climate smart agricultural technologies to minimize crop losses and poor yields. Furthermore, the capacity of Agricultural Extension Assistants for interpreting and applying seasonal weather forecasts in farming activities should be improved so that they efficiently help farmers to accurately select planting dates of crops for each season to coincide with the rains. This is necessary for avoiding crop failure from improper timing of the rainfall seasons.



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viii. Key climate-smart technologies such as surface water conservation for the maximization of water use by crops under stressful climatic conditions, minimum tillage that seeks to conserve moisture throughout the farming season, and contour plough for the prevention of runoffs that wash away the top soil nutrients and also promotes water retention for crop use on slope should be encouraged. Improved cassava varieties that spread out their leaves to form canopies and limit the rate of evaporation from the soil should also be made available to farmers and they should be encourage to use them, especially the male farmers whose rate of adoption of improved cassava varieties is very low.

ix. In addition to vii, insurance companies in collaboration with ADB could formulate insurance policies that are meant insure farmers against future hazards of climate variation which are likely to adversely affect crop yields. The ADB could also come up with financial package with appropriated business and training models specifically targeted at farmers to help them diversify into alternative business venture. These ventures could serve as alternative sources of livelihoods meant to augment their faming occupation so that in times of bad harvest or poor yields they can rely on the alternative business.

x. One way of enhancing the adaptive capacity of farmers according to the study is support from spouse, which the males are majority beneficiaries because they believe that it is obligatory of their wives to support on their farms. Thus, males should be encouraged to support their wives to diversify their livelihood activities or lend support to their spouses on their farms so



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that they can properly withstand the challenges of climate variation.

xi. Most farmers do not use the improved cassava varieties that are climate resilient, they rather continue with the indigenous and old varieties whose resilience to climate variation is compromised over time. One of the reasons for the non-usage of the improved varieties is that they lack certain qualities the farmers are looking out for, and hence make them less attractive. Some are simply not aware of their existence. It is thus suggested that authorities should endeavor to incorporate male and female farmers' desires in the development of improved varieties. They should ensure that newly released varieties are appealing to both genders since the farming occupation involves as many males and females. The Council for Scientific and Industrial Research (CSIR) is already taking steps in this direction in collaboration with other development partners and should be supported to intensify their efforts.

**Key Areas for Further Research**

The scope of this study was limited to a district in the Central Region, and hence the results are from to this geographical area. As such, research on a gender perspective in the adaptation to climate variation should cover all districts where the cultivation of cassava is done to broaden the scope of the research objective and the application of the results. This will provide a better insight into how male and female cassava farmers adapt to climate variation across the country. This will provide policy makers, development practitioners, agencies and researchers the opportunity to better address issues about gender



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and the adaptation to climate variation that are affecting cassava production in the Ghana.

Further research is required to deepen the understanding of the relationship between gender, adaptation to climate variation and other crops production. Research should be done to assess how traditional laws, socio-cultural practices and traditional family farming practices that affect adaptations to climate variation in all the regions in Ghana.

In conclusion, there are a number of areas where interventions can be made by both governmental and non-governmental agencies in relation to adaptation of climate smart technologies for the production of other crops in the country. This can be achieved by putting up a consolidated implementation plan that would ensure that the required technologies and information such as early warning systems, weather prediction kits, improved crop varieties that will enhance productivity are readily available for easy access to farmers. Farmers' traditional practices such as changing planting dates to coincide with rains as a method of adapting to extreme weather events can be enhanced with accurate weather prediction skills through capacity building. Most importantly, policies that will ensure equity in the distribution and access to these resources among male and female farmers should be integral part of the implementation plan since it has being established that gender dimensions exist in the vulnerability and adaptations to climate variation by cassava farmers in the study area. Above all, it should be noted that the lessons derived from this thesis are important not only for the study area but also for all parts of Ghana where agriculture is practiced.



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# APPENDICES

## Appendix A

**RAINFALL FOR AGONA SWEDRU**

| Year | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1984** | 42.5 | 12.7 | 80.0 | 71.6 | 209.0 | 124.4 | 66.4 | 178.4 | 155.8 | 203.3 | 70.6 | 30.3 |
| **1985** | 25.6 | 54.4 | 155.6 | 32.3 | 274.3 | 133.2 | 104.5 | 70.8 | 99.8 | 117.3 | 49.8 | |
| **1986** | 36.6 | 87.2 | 71.9 | 169.9 | 141.2 | 166.4 | 41.3 | 19.4 | 30.3 | 112.2 | 79.2 | 12.5 |
| **1987** | 18.3 | 55.4 | 126.7 | 104.4 | 130.7 | 62.7 | 63.9 | 104.5 | 194.0 | 192.5 | 37.5 | 34.3 |
| **1988** | 0.8 | 46.0 | 80.3 | 85.9 | 146.4 | 251.1 | 48.1 | 21.8 | 83.1 | 133.5 | 143.1 | 27.1 |
| **1989** | 7.1 | 20.6 | 155.2 | 78.0 | 187.5 | 225.2 | 94.6 | 100.5 | 85.8 | 108.2 | 54.8 | 5.9 |
| **1990** | 27.9 | 26.5 | 24.6 | 120.4 | 110.2 | 125.2 | 46.9 | 7.2 | 62.9 | 141.6 | 101.6 | 124.5 |
| **1991** | 78.9 | 24.2 | 81.4 | 203.2 | 293.5 | 151.8 | 472.5 | 47.0 | 28.2 | 38.6 | 114.9 | 9.9 |
| **1992** | 0.0 | 0.0 | 22.9 | 101.6 | 202.1 | 106.7 | 51.6 | 7.9 | 102.9 | | 132.0 | 36.7 |
| **1993** | 2.5 | 78.5 | 35.4 | 119.4 | 88.4 | 207.4 | 9.7 | 63.2 | 205.4 | 156.8 | 101.4 | 8.9 |
| **1994** | 81.0 | 26.9 | 52.7 | 78.5 | 243.7 | 231.8 | 14.6 | 51.4 | 96.6 | 170.4 | 62.0 | 0.0 |
| **2001** | | | | 98.8 | 175.2 | 246.5 | 89.3 | 11.4 | 81.2 | 92.5 | 133.3 | 55.7 |
| **2002** | 36.1 | 96.7 | 41.0 | 140.7 | 101.6 | 263.5 | 205.2 | 33.3 | 33.9 | 182.0 | 154.9 | 29.1 |
| **2003** | 22.5 | 78.8 | 129.9 | 183.4 | 69.8 | 172.7 | 19.6 | 44.6 | 183.8 | 175.8 | 70.8 | 30.7 |
| **2004** | 28.1 | 72.6 | 64.4 | 37.7 | 118.9 | 92.0 | 132.0 | 12.5 | 180.1 | 217.2 | 56.0 | 18.2 |
| **2005** | 8.1 | 3.6 | 30.7 | 116.7 | 223.6 | 315.6 | 39.0 | 36.2 | 31.6 | 112.6 | 113.7 | 81.9 |
| **2006** | 66.1 | 48.2 | 52.5 | 209.1 | 298.4 | 305.7 | 68.3 | 54.5 | 121.2 | 147.8 | 102.7 | 36.3 |
| **2007** | 0.0 | 43.0 | 141.3 | 191.9 | 183.0 | 281.8 | 114.2 | 134.4 | 127.1 | 222.6 | 39.2 | 14.6 |
| **2008** | 10.6 | 30.0 | 200.3 | 219.7 | 357.3 | 231.4 | 24.8 | | | | | |
| **2009** | 18.5 | 69.1 | 34.7 | 75.3 | 141.3 | 332.0 | 174.4 | 41.1 | 39.3 | 61.2 | 193.5 | 32.6 |



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| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2010** | 111.4 | 46.4 | 131.2 | 162.0 | 268.4 | 392.3 | 76.0 | 58.6 | 196.9 | 284.9 | 84.8 | 49.0 |
| **2011** | 7.3 | 92.2 | 17.1 | 160.3 | 138.6 | 257.4 | 132.4 | 41.9 | 161.9 | 99.9 | 0.0 | |
| **2012** | 0.0 | | | | | 315.5 | 107.4 | 22.2 | 167.1 | 200.6 | 128.1 | 31.8 |
| **2013** | 11.7 | 17.9 | 84.0 | 79.0 | 132.5 | 209.9 | 20.3 | 1.7 | 75.5 | 109.3 | 116.9 | 49.9 |
| **2014** | 3.6 | 35.3 | 172.4 | 182.3 | 188.8 | 216.5 | 165.7 | 208.7 | 192.1 | 69.9 | 115.5 | 255.7 |

Source: Ghana Meteorological Agency

**MIN TEMP FOR AGONA SWEDRU**



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| Year | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1984** | 22.8 | 22.2 | 23.7 | 23.2 | 23.1 | 22.5 | 22.4 | 22.6 | 22.3 | 22.3 | 22.3 | 21.5 |
| **1985** | 22.4 | 22.5 | 23.4 | 23.3 | 22.8 | 22.3 | 21.9 | 22.5 | 22.3 | 22.3 | 22.4 | |
| **1986** | | | | 20.5 | 20.5 | 20.0 | 20.2 | 20.1 | 21.3 | 21.8 | 21.7 | 20.7 |
| **1987** | 22.9 | 23.1 | 22.8 | 23.2 | 23.0 | 22.9 | 22.5 | 22.6 | 22.3 | 22.1 | 22.0 | 21.4 |
| **1988** | 21.2 | 22.8 | 22.9 | 23.1 | 22.9 | 22.1 | 21.5 | 21.7 | 21.8 | 21.7 | 21.4 | 21.1 |
| **1989** | 20.2 | 21.8 | 22.2 | 22.5 | 22.0 | 21.6 | 21.6 | 21.3 | 21.5 | 21.8 | 22.0 | 21.8 |
| **1990** | 21.8 | 21.7 | 23.1 | 22.7 | 22.7 | 22.3 | 21.4 | 21.2 | 21.6 | 21.6 | 22.0 | 21.5 |
| **1991** | 21.4 | 22.6 | 22.6 | 22.0 | 22.5 | 22.6 | 21.7 | 21.7 | 21.8 | 21.3 | 21.6 | 22.2 |
| **1992** | 20.0 | 23.1 | 23.6 | 23.1 | 22.6 | 22.0 | 21.6 | 21.1 | 21.8 | 21.8 | 21.5 | 21.9 |
| **1993** | 20.5 | 22.5 | 22.0 | 22.6 | 23.4 | 22.7 | 21.9 | 21.5 | 22.0 | 22.3 | 22.4 | 23.2 |
| **1994** | 22.0 | 23.6 | 23.6 | 23.9 | 23.1 | 22.9 | 22.7 | 22.3 | 22.8 | 22.6 | 22.4 | 21.9 |
| **1995** | | 24.1 | 23.4 | 23.7 | 23.6 | 23.0 | 22.9 | 23.0 | 22.9 | 22.8 | 22.8 | 23.0 |
| **1996** | 23.0 | 23.7 | 23.5 | 23.5 | 22.9 | 22.9 | 22.8 | 22.4 | 22.4 | 22.6 | 22.7 | 23.2 |
| **1997** | 23.3 | 23.3 | 23.4 | 23.4 | 23.2 | 22.9 | 22.2 | 22.2 | 23.0 | 23.2 | 22.9 | 22.8 |
| **1998** | 22.0 | 24.5 | 25.4 | 25.4 | 24.0 | 23.3 | 22.9 | 22.1 | 22.9 | 23.1 | 23.1 | 22.9 |
| **1999** | 23.4 | 23.3 | 23.3 | 23.6 | 23.0 | 22.9 | 22.5 | 22.2 | 22.3 | 22.6 | 22.2 | 22.4 |
| **2000** | 22.9 | 22.1 | 23.9 | 23.7 | 23.3 | 23.1 | 22.2 | 22.4 | 22.7 | 22.6 | 22.6 | 23.1 |
| **2001** | 23.3 | 22.8 | 23.0 | 23.7 | 23.7 | 22.9 | 22.4 | 22.2 | 22.5 | 23.0 | 22.8 | 23.7 |
| **2002** | 22.9 | 23.8 | 24.0 | 23.8 | 24.0 | 23.1 | 23.2 | 22.1 | 22.8 | 22.9 | 22.6 | 22.5 |
| **2003** | 23.4 | 23.8 | 23.8 | 23.8 | 23.6 | 23.0 | 22.5 | 22.3 | 23.3 | 23.2 | 23.1 | 23.0 |
| **2004** | 23.7 | 23.5 | 24.2 | 24.2 | 23.6 | 22.9 | 22.7 | 22.7 | 22.9 | 23.0 | 23.4 | 23.9 |
| **2005** | 22.0 | 25.1 | 24.2 | 24.2 | 23.3 | 22.7 | 21.8 | 21.4 | 22.2 | 22.5 | 22.7 | 22.9 |
| **2006** | 23.4 | 23.8 | 23.1 | 23.6 | 22.4 | 21.8 | 20.7 | 20.3 | 20.2 | 20.3 | 20.5 | 21.2 |



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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2007** | 19.6 | 23.4 | 22.9 | 22.9 | 22.1 | 20.8 | 19.5 | 18.9 | 18.5 | 18.4 | 19.2 | 21.5 |
| **2008** | 19.6 | 23.2 | 22.9 | 22.7 | 22.3 | 22.1 | | | | | | |
| **2009** | | 23.8 | 23.6 | 23.1 | 22.9 | 22.2 | 21.7 | 22.1 | 22.2 | 22.8 | 22.8 | 23.0 |
| **2010** | 23.5 | 24.2 | 24.5 | 24.1 | 23.8 | 22.6 | 21.6 | 21.4 | 21.4 | 22.7 | 22.8 | 22.7 |
| **2011** | 21.2 | 22.6 | 23.6 | 23.7 | 22.8 | 22.2 | 21.0 | 21.3 | 22.3 | 23.1 | 22.6 | 22.3 |
| **2012** | 21.8 | 22.6 | 30.1 | 23.9 | 22.7 | 22.2 | 21.9 | 21.5 | 22.1 | 22.5 | 22.5 | 22.3 |
| **2013** | 22.1 | 22.9 | 24.0 | 23.2 | 22.7 | 22.5 | 22.1 | 21.5 | | 22.6 | 22.7 | 22.0 |
| **2014** | 22.7 | 22.6 | 23.2 | 23.0 | 23.1 | 22.9 | 22.4 | 22.1 | 22.6 | 23.3 | 23.3 | 22.3 |

Source: Ghana Meteorological Agency

**MAX TEMP FOR AGONA SWEDRU**

| Year | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1984** | 33.3 | 34.4 | 34.6 | 33.6 | 32.2 | 31.0 | 30.7 | 30.3 | 30.8 | 31.3 | 32.0 | 32.3 |
| **1985** | 32.6 | 33.7 | 33.2 | 33.4 | 30.9 | 29.8 | 29.1 | 29.7 | 30.2 | 31.8 | 32.4 | |
| **1986** | 33.2 | 34.0 | 33.3 | 33.2 | 32.4 | 30.4 | 28.3 | 29.3 | 30.2 | 30.9 | 31.6 | 31.9 |
| **1987** | 33.3 | 33.7 | 33.3 | 33.6 | 33.2 | 31.7 | 30.8 | 30.0 | 29.7 | 31.1 | 32.5 | 32.1 |
| **1988** | 33.5 | 34.1 | 33.6 | 33.6 | 32.8 | 30.5 | 29.1 | 29.0 | 29.9 | 31.1 | 31.8 | 31.4 |
| **1989** | 32.6 | 34.4 | 33.7 | 33.6 | 32.0 | 30.3 | 28.7 | 28.7 | 29.7 | 30.8 | 32.2 | 32.1 |
| **1990** | 32.9 | 34.3 | 34.8 | 33.4 | 32.4 | 30.7 | 28.3 | 28.7 | 30.2 | 31.6 | 32.3 | 32.2 |
| **1991** | 32.6 | 33.5 | 34.0 | 33.0 | 31.7 | 30.5 | 29.1 | 28.0 | 30.2 | 31.0 | 31.9 | 31.7 |
| **1992** | 33.6 | 35.0 | 34.5 | 33.6 | 32.1 | 30.2 | 28.0 | 28.8 | 30.1 | 31.2 | 31.5 | 31.9 |
| **1993** | 33.4 | 33.5 | 34.0 | 33.7 | 33.2 | 30.7 | 28.9 | 28.7 | 30.8 | 32.0 | 32.6 | 32.6 |
| **1994** | 32.5 | 33.5 | 33.9 | 33.8 | 32.2 | 30.3 | 29.3 | 29.7 | 29.4 | 31.2 | 32.4 | 33.3 |
| **1995** | | 34.7 | 33.5 | 34.2 | 32.8 | 31.2 | 29.7 | 29.8 | 31.4 | 32.1 | 32.4 | 32.7 |
| **1996** | 33.2 | 34.1 | 34.0 | 33.9 | 32.1 | 30.6 | 29.4 | 28.1 | 29.3 | 31.9 | 32.4 | 32.1 |
| **1997** | 33.5 | 34.5 | 33.8 | 32.6 | 32.1 | 29.9 | 28.9 | 29.9 | 31.9 | 32.6 | 32.7 | 32.5 |
| **1998** | 33.7 | 36.2 | 36.0 | 36.1 | 33.4 | 32.2 | 30.0 | 29.6 | 31.0 | 31.7 | 32.8 | 32.6 |
| **1999** | 32.4 | 34.3 | 34.7 | 33.1 | 32.6 | 31.4 | 29.4 | 30.2 | 30.1 | 31.2 | 32.0 | 32.4 |
| **2000** | 32.6 | 34.0 | 34.5 | 34.0 | 33.1 | 30.3 | 29.7 | 30.2 | 30.9 | 32.2 | 33.2 | 33.0 |
| **2001** | 33.5 | 34.6 | 33.6 | 33.9 | 33.5 | 31.1 | 29.5 | 28.7 | 29.7 | 32.2 | 32.5 | 33.0 |
| **2002** | 32.9 | 34.9 | 34.5 | 33.6 | 33.7 | 31.1 | 29.5 | 29.2 | 31.1 | 32.1 | 32.8 | 32.7 |
| **2003** | 33.3 | 34.8 | 34.4 | 33.2 | 33.3 | 30.7 | 31.2 | 29.7 | 31.4 | 32.2 | 33.1 | 33.0 |
| **2004** | 32.9 | 34.6 | 34.7 | 33.5 | 32.5 | 30.9 | 29.2 | 29.8 | 31.8 | 31.7 | 32.8 | 33.1 |
| **2005** | 33.7 | 35.5 | 35.8 | 35.1 | 32.7 | 29.8 | 30.0 | 28.6 | 31.2 | 32.6 | 33.1 | 22.9 |
| **2006** | 33.3 | 35.0 | 34.3 | 34.3 | 32.8 | 32.2 | 29.9 | 28.9 | 30.4 | 32.0 | 33.5 | 33.6 |
| **2007** | 33.4 | 35.2 | 34.9 | 34.4 | 34.2 | 31.1 | 30.1 | 30.1 | 31.3 | 32.3 | 33.5 | 34.0 |



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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2008** | 34.3 | 35.6 | 34.7 | 33.4 | 33.5 | 31.8 | | | | | | |
| **2009** | | 34.8 | 34.8 | 34.5 | 34.1 | 31.4 | 29.5 | 28.9 | 31.2 | 33.3 | 33.1 | 33.6 |
| **2010** | 33.8 | 35.3 | 34.8 | 35.0 | 33.5 | 31.5 | 30.3 | 30.6 | 31.3 | 33.1 | 33.5 | 33.8 |
| **2011** | 34.0 | 34.5 | 35.0 | 35.5 | 33.2 | 31.9 | 30.0 | 29.8 | 31.5 | 32.9 | 33.4 | 33.6 |
| **2012** | 33.9 | 34.6 | 35.1 | 35.2 | 33.5 | 30.2 | 30.8 | 29.7 | 31.3 | 32.2 | 33.7 | 34.3 |
| **2013** | 35.2 | 36.3 | 36.6 | 34.8 | 33.2 | 31.3 | 29.8 | 30.4 | | 32.8 | 33.4 | 33.7 |
| **2014** | 33.9 | 34.4 | 35.1 | 34.4 | 33.6 | 31.4 | 30.0 | 29.3 | 30.9 | 32.6 | 33.8 | 33.9 |

Source: Ghana Meteorological Agency

**RAINFALL FOR KWANYAKO**

| Year | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1984** | 17.5 | 6.4 | 95.2 | 76.5 | 153.7 | 149.9 | 85.9 | 36.4 | 43.6 | 100.0 | | 0.0 |
| **1985** | 18.8 | 22.6 | 89.4 | 0.0 | 88.3 | 98.8 | 137.9 | 168.9 | 199.5 | 175.2 | 65.0 | 0.0 |
| **1995** | | | | | | 400.2 | 71.2 | 43.4 | 49.2 | 103.0 | 74.1 | 40.7 |
| **1996** | 27.4 | 29.6 | 47.3 | 148.5 | 225.0 | 187.4 | 122.1 | 73.6 | 14.2 | 125.2 | 65.6 | 15.7 |
| **1997** | 44.0 | 0.0 | 156.2 | 220.2 | 195.0 | 453.3 | 51.6 | 7.8 | 50.2 | 99.2 | 160.1 | 76.0 |
| **1998** | 0.0 | 3.3 | 39.0 | 24.5 | 170.0 | 225.4 | 72.8 | 78.7 | 71.8 | 143.0 | 180.8 | 37.5 |
| **1999** | 28.0 | 34.5 | 74.2 | 88.3 | 142.1 | 293.6 | 163.7 | 103.0 | 90.4 | 97.7 | 119.9 | 26.2 |
| **2000** | 56.3 | 35.1 | 77.1 | 86.2 | 124.3 | 151.0 | 28.1 | 25.5 | 53.4 | 151.9 | 38.3 | 49.7 |
| **2001** | | 44.8 | 130.2 | 122.0 | 236.6 | 233.0 | 182.8 | 27.9 | 74.5 | 113.7 | 91.2 | 8.7 |
| **2002** | 19.0 | 25.5 | 45.4 | 108.8 | 55.5 | 292.9 | 159.3 | 30.3 | 102.1 | 120.0 | 121.5 | 65.7 |
| **2003** | 26.2 | 68.1 | 148.9 | 163.5 | 64.6 | 188.2 | 89.5 | 76.9 | 96.8 | 267.3 | 86.9 | 9.9 |
| **2004** | 27.6 | 36.9 | 92.2 | 118.5 | 161.5 | 110.3 | 204.3 | 19.1 | 207.9 | 148.9 | 146.3 | 34.3 |
| **2005** | 36.6 | 6.7 | 52.4 | 188.8 | 135.3 | 214.3 | 43.0 | 32.8 | 81.7 | 133.7 | 112.6 | 44.4 |
| **2006** | 129.1 | 67.5 | 43.2 | 147.7 | 303.0 | 346.1 | 42.2 | 18.8 | 148.2 | 159.1 | 67.7 | 9.9 |
| **2007** | 0.0 | 22.8 | 161.4 | 237.8 | 104.4 | 230.8 | 112.2 | 66.9 | 191.2 | 240.4 | 79.6 | 4.3 |
| **2008** | 20.2 | 34.2 | 167.3 | 218.8 | 261.7 | 143.4 | 195.3 | 111.5 | 63.2 | 57.7 | 127.2 | 155.6 |
| **2009** | 14.8 | 57.0 | 47.8 | 126.0 | 138.7 | 159.7 | 175.3 | 22.6 | 20.4 | 122.7 | 163.6 | 63.3 |
| **2010** | 63.7 | 16.1 | 91.4 | 159.2 | 102.7 | 384.5 | 61.6 | 100.6 | 144.5 | 306.2 | 77.7 | 98.8 |
| **2011** | 21.6 | 130.7 | 25.4 | 121.2 | 225.6 | 181.7 | 141.0 | 44.5 | 86.1 | 249.7 | 151.5 | 3.4 |
| **2012** | 41.8 | 40.8 | 52.0 | 113.1 | 118.1 | 199.3 | 57.5 | 12.9 | 57.9 | 174.5 | 84.4 | 76.7 |
| **2013** | 34.2 | 11.9 | 63.9 | 55.5 | 87.8 | 140.6 | 68.4 | 3.9 | 128.6 | 167.7 | 151.5 | 34.6 |
| **2014** | 0.0 | 94.4 | 131.4 | 137.5 | 188.0 | 297.3 | 137.0 | 155.9 | 73.3 | 73.0 | 154.2 | 52.7 |

Source: Ghana Meteorological Agency

**MIN TEMP FOR KWANYAKO**



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| Year | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1984 | 19.9 | 20.9 | 20.7 | 22.3 | 20.0 | 21.1 | 21.3 | 20.2 | 20.3 | 21.1 | | 21.1 |
| 1985 | 20.7 | 22.6 | 21.5 | 22.8 | 20.6 | 20.8 | 21.7 | 22.7 | 22.6 | 22.8 | 21.9 | 21.5 |
| 1995 | | | | | | 23.0 | 22.2 | 22.5 | 22.0 | 21.7 | 21.3 | 20.5 |
| 1996 | 21.0 | 22.8 | 22.2 | 22.7 | 21.6 | 21.9 | 21.9 | 21.1 | 22.1 | 22.0 | 21.5 | 21.9 |
| 1997 | 21.4 | 21.0 | 22.4 | 23.6 | 23.4 | 22.6 | 22.7 | 22.2 | 23.2 | 23.0 | 23.2 | 22.6 |
| 1998 | 23.1 | 24.0 | 23.5 | 24.6 | 23.2 | 23.1 | 22.6 | 22.3 | 22.9 | 23.0 | 22.6 | 22.4 |
| 1999 | 22.8 | 22.3 | 22.5 | 23.1 | 22.8 | 22.6 | 22.4 | 21.3 | 22.2 | 22.2 | 21.6 | 21.2 |
| 2000 | 21.8 | 20.4 | 22.9 | 23.0 | 22.7 | 22.6 | 21.4 | 22.1 | 22.4 | 22.1 | 22.1 | 21.9 |
| 2001 | | 21.8 | 22.1 | 22.6 | 22.5 | 22.0 | 21.3 | 21.3 | 21.8 | 22.0 | 21.9 | 22.0 |
| 2002 | 21.8 | 22.5 | 23.2 | 23.3 | 23.3 | 22.1 | 22.1 | 21.3 | 22.8 | 22.6 | 22.0 | 20.9 |
| 2003 | 22.3 | 22.8 | 23.3 | 23.0 | 22.8 | 21.6 | 20.9 | 19.9 | 22.0 | 22.5 | 22.4 | 21.3 |
| 2004 | 22.7 | 22.6 | 23.0 | 23.5 | 22.6 | 22.3 | 22.2 | 21.1 | 22.4 | 22.5 | 22.2 | 22.3 |
| 2005 | 20.2 | 23.6 | 23.2 | 23.9 | 23.5 | 22.5 | 22.2 | 22.0 | 22.8 | 22.8 | 22.3 | 22.3 |
| 2006 | 22.4 | 22.7 | 22.4 | 23.0 | 22.0 | 21.7 | 22.3 | 22.3 | 22.4 | 22.7 | 22.4 | 22.9 |
| 2007 | 19.3 | 23.4 | 23.0 | 23.3 | 23.1 | 22.1 | 22.0 | 22.4 | 22.7 | 22.4 | 22.2 | 22.3 |
| 2008 | 17.8 | 22.9 | 22.6 | 22.4 | 22.5 | 22.3 | 21.8 | 22.0 | 22.3 | 22.3 | 22.1 | 22.4 |
| 2009 | 21.3 | 23.1 | 22.9 | 23.1 | 22.8 | 22.6 | 22.2 | 22.4 | 22.5 | 22.8 | 22.7 | 22.6 |
| 2010 | 22.7 | 23.3 | 23.9 | 23.9 | 23.1 | 22.4 | 21.5 | 22.0 | 22.5 | 22.5 | 22.3 | 21.8 |
| 2011 | 20.5 | 22.0 | 22.7 | 23.0 | 23.0 | 23.4 | 22.8 | 22.5 | 22.8 | 22.6 | 22.0 | 21.8 |
| 2012 | 21.2 | 21.8 | 22.8 | 22.9 | 22.9 | 22.7 | 22.0 | 21.4 | 22.5 | 22.6 | 22.5 | 22.2 |
| 2013 | 21.3 | 23.2 | 23.2 | 22.9 | 22.9 | 22.5 | 22.2 | 21.3 | 22.4 | 22.4 | 22.1 | 20.2 |
| 2014 | 21.7 | 22.2 | 22.7 | 22.6 | 22.9 | 22.5 | 22.1 | 22.0 | 22.1 | 22.4 | 21.8 | 22.0 |

Source: Ghana Meteorological Agency

**X TEMP FOR KWANYAKO**



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| Year | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1984** | 33.8 | 35.2 | 36.2 | 37.1 | 34.5 | 33.6 | 35.8 | 31.6 | 31.8 | 32.3 | | 32.6 |
| **1985** | 33.9 | 35.2 | 36.1 | 35.3 | 31.5 | 31.4 | 32.3 | 32.4 | 32.2 | 32.6 | 33.4 | 33.0 |
| **1995** | | | | | | 32.0 | 29.9 | 30.1 | 32.2 | 32.9 | 33.3 | 32.6 |
| **1996** | 33.0 | 34.3 | 35.0 | 34.3 | 32.5 | 31.4 | 30.9 | 28.8 | 29.9 | 31.9 | 32.7 | 32.0 |
| **1997** | 33.1 | 33.5 | 33.4 | 32.7 | 32.3 | 29.3 | 30.3 | 29.8 | 31.8 | 32.7 | 32.6 | 32.8 |
| **1998** | 33.6 | 36.6 | 35.1 | 36.0 | 33.5 | 32.0 | 30.2 | 30.0 | 31.6 | 32.2 | 33.1 | 33.0 |
| **1999** | 33.0 | 34.5 | 34.4 | 33.4 | 33.0 | 31.5 | 29.6 | 30.4 | 30.0 | 31.3 | 32.5 | 32.6 |
| **2000** | 32.6 | 34.6 | 34.2 | 33.6 | 33.0 | 30.6 | 29.7 | 28.8 | 30.6 | 31.6 | 33.2 | 32.8 |
| **2001** | | 35.3 | 33.6 | 33.8 | 33.6 | 30.9 | 29.5 | 28.2 | 29.8 | 32.4 | 32.5 | 32.3 |
| **2002** | 33.6 | 35.2 | 34.8 | 33.8 | 33.7 | 30.8 | 29.4 | 29.4 | 31.9 | 32.9 | 33.0 | 32.9 |
| **2003** | 33.4 | 35.0 | 35.4 | 34.0 | 34.2 | 31.2 | 31.1 | 30.4 | 32.0 | 32.9 | 33.4 | 33.3 |
| **2004** | 33.9 | 35.6 | 35.5 | 34.2 | 33.2 | 31.5 | 30.1 | 30.0 | 31.7 | 32.5 | 32.6 | 33.4 |
| **2005** | 32.5 | 35.2 | 34.6 | 34.6 | 33.1 | 30.1 | 30.2 | 29.4 | 31.8 | 33.6 | 33.8 | 33.0 |
| **2006** | 33.4 | 33.6 | 34.3 | 33.9 | 32.4 | 32.0 | 30.7 | 29.2 | 31.4 | 32.8 | 33.2 | 33.6 |
| **2007** | 34.3 | 34.8 | 33.8 | 34.4 | 33.6 | 31.3 | 30.4 | 30.3 | 31.3 | 32.3 | 33.0 | 33.3 |
| **2008** | 34.6 | 35.0 | 33.9 | 33.2 | 32.7 | 31.3 | 30.9 | 30.6 | 31.2 | 33.1 | 33.2 | 33.6 |
| **2009** | 34.6 | 34.6 | 34.7 | 33.8 | 34.0 | 31.7 | 30.1 | 30.2 | 31.9 | 33.2 | 33.7 | 33.9 |
| **2010** | 34.3 | 35.6 | 35.4 | 34.9 | 33.7 | 31.4 | 31.8 | 30.3 | 30.8 | 32.8 | 33.3 | 34.0 |
| **2011** | 33.9 | 34.2 | 35.3 | 35.3 | 33.8 | 31.4 | 30.1 | 29.3 | 30.8 | 32.0 | 33.0 | 33.8 |
| **2012** | 34.4 | 33.9 | 35.1 | 34.2 | 33.7 | 30.8 | 30.6 | 29.3 | 31.6 | 32.6 | 33.7 | 33.3 |
| **2013** | 34.7 | 35.0 | 35.8 | 34.4 | 33.6 | 32.0 | 29.5 | 29.8 | 30.3 | 31.9 | 32.6 | 33.7 |
| **2014** | 34.5 | 34.6 | 34.4 | 34.2 | 33.6 | 32.2 | 29.8 | 28.8 | 30.4 | 31.9 | 33.5 | 33.1 |

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**RAINFALL FOR POMADZE**

| Year | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1984** | 7.4 | 0.0 | 5.9 | 103.3 | 155.8 | 193.1 | 34.1 | 45.7 | 58.2 | 68.9 | | |
| **1985** | 96.3 | 0.0 | 43.7 | 101.3 | 308.4 | 85.8 | 54.9 | 8.1 | 35.8 | 48.7 | 57.9 | 0.0 |
| **1986** | 4.8 | 17.0 | 40.4 | 78.8 | 138.4 | 114.0 | 58.2 | 0.0 | 20.1 | 116.6 | 49.5 | 3.3 |
| **1987** | 11.9 | 0.0 | 139.4 | 102.6 | 97.5 | 115.4 | 6.6 | | | 152.2 | 10.7 | 13.2 |
| **1988** | 0.0 | 28.7 | 92.2 | 28.0 | 98.0 | 226.9 | 20.4 | 11.6 | 56.0 | 112.3 | 53.9 | 28.4 |
| **1989** | 0.0 | 0.5 | 96.3 | 79.8 | 238.0 | 330.9 | 17.0 | 34.6 | 67.4 | 118.4 | 0.3 | 2.3 |
| **1990** | 3.1 | 36.1 | 17.1 | 111.4 | 81.2 | 150.9 | 43.5 | 2.8 | 61.8 | 75.6 | 20.1 | 49.0 |
| **1991** | 43.2 | 24.9 | 30.8 | | 421.4 | 77.3 | 302.4 | 25.5 | 50.4 | 86.4 | 0.0 | 0.0 |
| **1992** | 0.0 | 0.0 | 35.9 | 68.9 | 173.2 | 52.3 | 25.3 | 5.5 | 43.8 | 36.2 | 2.8 | 10.6 |
| **1993** | 23.1 | 36.6 | 7.4 | 106.7 | 41.7 | 167.9 | 2.1 | 36.8 | 36.1 | 22.7 | 78.1 | 7.9 |
| **1995** | 0.0 | 0.6 | 83.1 | 126.1 | 69.3 | 301.3 | 139.6 | 26.2 | 24.2 | 54.4 | 74.2 | 16.2 |
| **1996** | 2.1 | 15.0 | 42.4 | 143.7 | 293.8 | 284.8 | 86.9 | 47.3 | 11.1 | 21.1 | 80.4 | 33.6 |
| **1997** | 2.5 | 0.0 | 174.7 | 167.3 | 159.9 | 293.5 | 53.2 | 1.9 | 23.1 | 37.6 | 31.7 | 129.9 |
| **1998** | 35.0 | 15.4 | 0.0 | 10.8 | 186.4 | 86.3 | 23.7 | 10.9 | 7.8 | 148.7 | 1.1 | 39.0 |
| **1999** | 48.7 | 25.1 | 30.7 | 116.2 | 132.9 | 393.6 | 68.3 | 24.5 | 22.3 | 22.8 | 18.7 | 2.8 |
| **2000** | 12.0 | 0.4 | 49.2 | 47.0 | 129.9 | 126.5 | 10.4 | 31.0 | 14.4 | 80.8 | 3.7 | 39.0 |
| **2001** | 0.0 | 17.6 | 20.9 | 91.6 | 175.9 | 265.4 | 55.0 | 8.7 | 106.8 | 19.1 | 26.7 | 12.8 |
| **2002** | 13.9 | 89.0 | 44.6 | 121.5 | 176.8 | 351.3 | 49.4 | 22.6 | 5.2 | 27.7 | 42.8 | 5.3 |
| **2003** | 7.8 | 19.1 | 96.4 | 135.1 | 45.1 | 156.5 | 39.4 | 9.8 | 47.4 | 107.5 | 35.3 | 9.0 |
| **2004** | 11.0 | 35.8 | 68.7 | 11.3 | 84.8 | 66.0 | 66.2 | 11.3 | 115.1 | 197.0 | 30.3 | 3.0 |
| **2005** | 1.2 | 19.0 | 82.6 | 75.4 | 213.9 | 212.3 | 9.2 | 10.5 | 15.9 | 76.4 | 39.8 | 35.5 |
| **2006** | 0.0 | 39.8 | 19.9 | 71.6 | 233.0 | 128.8 | 30.4 | 51.1 | 52.6 | 148.0 | 6.1 | 0.8 |



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| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2007** | 0.0 | 2.4 | 97.0 | 107.8 | 94.3 | 119.7 | 123.8 | 63.3 | 111.7 | 155.3 | 40.8 | 25.6 |
| **2008** | 29.4 | 0.0 | 15.6 | 206.4 | 213.3 | 197.9 | 103.6 | 28.6 | 43.9 | 27.5 | 108.5 | 102.8 |
| **2009** | 6.8 | 90.9 | 28.5 | 106.3 | 61.6 | 325.7 | 286.7 | 18.5 | 7.0 | 5.7 | 19.6 | 5.6 |
| **2010** | 79.0 | 128.1 | 31.9 | 60.1 | 107.5 | 264.6 | 52.2 | 36.9 | 258.6 | 90.3 | 31.4 | 22.8 |
| **2011** | 0.0 | 84.4 | 10.1 | 243.9 | 232.2 | 225.3 | 79.8 | 55.5 | 36.9 | 96.2 | 7.0 | 68.9 |
| **2012** | 11.7 | 9.6 | 31.9 | 63.9 | 215.8 | 176.0 | 32.9 | 14.8 | 51.6 | 172.9 | 31.1 | 26.8 |
| **2013** | 6.5 | 1.5 | | | | | | | | | | |

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# APPENDIX B

## DATA COLLECTION INSTRUMENT

Gender Dimensions in the Adaptation to Variations in the Climate by cassava farmers in the Awutu-Senya West District.

**Data Collection Instrument**

Objective of the Study

The main objective of the study was to assess gender dimensions in the adaptation to variations that occurred in the seasons by cassava farmers in the Awutu-Senya West District.

The main objective of the study was to explore the gender dimensions in the adaptation to climate variations by cassava farmers in the Awutu-Senya District.

The specific objectives were to:

1. explore the:
    a. gender perceptions on the causes of climate variation among cassava farmers in the Awutu Senya district;
    b. gender perceptions of the effects of climate variation on cassava production in the study area;
2. explore the gender dimensions of the factors influencing vulnerability to the adverse effects of climate variation among cassava farmers in the study area;
3. identify which gender is more vulnerable gender to the adverse effect climate variation;
4. explore the gender dimensions of the effects of climate variation on cassava production in the district;
5. identify the coping and adaptation strategies employed by each gender, and;
6. suggest further research into gender and agriculture as a whole



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**Data Collection Instrument**

**Section 1: Profile of Respondents**

**Demographic and Socio-economic data**

| No. | Questionnaire | Response |
|---|---|---|
| B01 | Respondent's Age group | 1. 20-29<br>2. 30-39<br>3. 40-49<br>4. 50-59<br>5. 60 and above |
| B02 | Sex | 1. Male<br>2. Female |
| B03 | Marital status: **(Find out whether an individual's vulnerability is affected by his/her marital status)** | 1. single<br>2. married (i). monogamy ii). polygamy)<br>3. divorced<br>4. widow/widower<br>5. separated<br>6. co-habituating |

**Social Background**

| | | |
|---|---|---|
| S01 | Level of education | 1. No formal education<br>2. Basic<br>3. JHS/MSLC<br>4. SHS/O'L/A'L<br>5. Tertiary/Post Sec (Training College, Polytechnic, University, etc) |
| S02 | Religious Background; **(certain religious believes forbid men or women from indulging in certain activities)** | 1. Christianity<br>2. Islam<br>3. African traditional Religion<br>4. Atheist<br>5. Others (specify) |
| S03 | Which social group do you belong to? (**Certain** | 1. FBO |



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| | | |
|---|---|---|
| | **knowledge or skills are acquired through peer group interactions)** | 2. Peer Group<br>3. Club<br>4. Independent |
| S04 | What are underlining gender issues interms of Education of the girls or boy child? | |
| S05 | For how long have you been farming here? **(period of observable variations; 30 years)** | 1. < 1 year ( )<br>2. 1- 5 years ( )<br>3. 6-10 years ( )<br>4. 11-15 years ( )<br>5. 16- 20years ( )<br>6. 21-30 years ( )<br>7. More than 30 years ( ) |
| S06 | What is your Family Size? | Number ( ) |
| S07 | Details of family Members<br>1. Number of male adults (18yr and above)<br>2. Number of female adults (18yr and above)<br>3. Number of male children<br>4. Number of female children<br>5. Number of household members who earn income | |



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**Section 2: Farming Activities: - This section seeks to collect information on the farming activities of respondents and how arable land(s) is/are acquired. This will facilitate the understanding of how respondents adjust to variations in climate using certain farming strategies.**

| | | |
|---|---|---|
| F01 | How many farmlands do you have | 1. One<br>2. Two<br>3. Three<br>4. Four<br>5. More than four |
| F02 | What is the total size of your farmlands | 1. Under 1 acre<br>2. 1 -4 acres<br>3. 5 -10 acres<br>4. 11- 20 acres<br>5. Over 20 acres |
| F03 | How did you acquire the land(s) | 1. Owned by me<br>2. Purchased<br>3. Rented<br>4. Leased<br>5. Inherited<br>6. Belongs to spouse<br>7. Others(Specify) |
| F04 | Apart from 1and 6 in F03 how is access to land is with respect to your gender? | |
| F05 | How many acres of cassava farm do you have? | 1. Under 1 acre<br>2. 1 -4 acres<br>3. 5 -10 acres<br>4. 11- 20 acres<br>5. Over 20 acres |



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| | | |
|---|---|---|
| F06 | Apart from cassava, which other crops do you grow on the arable land? **(to determine if farmers use the cultivation of different crops as a method of adaptation)** | 1.<br>2.<br>3.<br>4. |
| F07 | How many farms of each crop do you have, including cassava?<br>Crop 1: Cassava: (eg, 3 farms)<br>Crop 2:<br>Crop 3:<br>Crop 4: | |
| F08 | What is the total farm size of each crop?<br>Crop 1: cassava (eg, 3 acres)<br>Crop: 2<br>Crop 3<br>Crop 4 | |
| F09 | Why do you have separate farms? | Reason1.<br>Reason2:<br>Reason3: |



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F10 What is the trend of yield per acre of the following crops over last three decades?

a. crop 1: cassava?
   i. Increasing
   ii. Stable/constant
   iii. fluctuating
   iv. decreasing

b. crop 2
   i. Increasing
   ii. Stable/constant
   iii. fluctuating
   iv. decreasing

v. crop 3
   i. Increasing
   ii. Stable/constant
   iii. fluctuating
   iv. decreasing

v. crop 4
   i. Increasing
   ii. Stable/constant
   iii. fluctuating
   iv. decreasing

F11 Which varieties of cassava do you grow?

a. CSIR-CRI Ampong
b. CSIR-CRI Buroni Bankye
c. CSIR-CRI Sika Bankye
d. CSIR-CRI Otuhia
e. Afisiafi
f. Others (provide, name)

(Rank the varieties in order of preference)

1.
2.
3.
4.
5.
6.



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| | | |
|---|---|---|
| F12 | Why the preference ( assign variety to a reason) | g. Optimal yield under harsh climatic conditions (eg CSIR-CRI Ampong, CSIR-CRI Buroni Bankye, etc)<br>1. Able to store for long (……………………………………)<br>2. High starch content (…………………………………….)<br>3. Good for fufu (……………………………………..)<br>4. Has good market price (………………………………………)<br>5. Requires minimum tillage<br>6. Others, specify………………………. Don't |
| F13 | Which of the varieties are: | 1. Drought tolerant/resilient (……………………………………)<br>2. Heat tolerant (……………………………………)<br>3. Flood tolerant (……………………………………)<br>4. Early maturing (……………………………………) |
| F14 | Which of these varieties are able to preserve for long? **(Farmer's own definition for long)** | 1.<br>2.<br>3.<br>4. |
| F15 | Why is one variety able to preserve longer than another? | |
| F16 | Do you use irrigation for cassava cultivation? | Yes<br>No |



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| | | |
|---|---|---|
| F17 | Do you apply fertilizer to your cassava farms/other crops? | Yes<br>No. |
| F18 | If yes to F15, why? | |
| F19 | Do you get any assistance from your spouse in your farming activities? | Yes<br>No |
| F20 | If yes to F19, Why should your spouse give your assistance on the farm? | |
| F21 | Do you think women should be in cassava farming? | 1. Yes<br>2. No<br>3. Don't know |
| F20 | If yes, Why? | |

**Section 3: Trends in Climate Variation and Seasonal Climate Conditions: - This is to find out farmer's knowledge about the weather, perception about climate variation and the causes of variations in climate from the farmer's view point.**

| | | |
|---|---|---|
| C01 | 1. when does the rainy season start here?<br>2. when does the dry season start here? | |
| C02 | Do you notice any changes in the weather from year to year over the last 30 years | i. Yes<br>ii. No<br>iii. Don't know |
| C03 | If yes to C02, kindly identify the years or period? | ii. last year<br>iii. two years ago<br>iv. three years ago<br>v. every other year<br>vi. every two year interval<br>vii. every three year interval<br>viii. every four year interval |
| C04 | What is the change? | 1. Increasing amount of rainfall<br>2. Decreasing amount of rainfall<br>3. High temperatures<br>4. Low temperatures<br>5. Extended rainy seasons |



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| | | |
|---|---|---|
| | | 6. Reduced rainy seasons<br>7. longer dry seasons<br>8. Reduced dry seasons<br>9. Rains do not fall at expected time<br>10. Increasing floods<br>11. Increasing droughts |
| C05 | What do you think has brought about the changes in seasonal rainfall? | |
| C06 | If yes to C05, how are you able to tell there have been changes? | |
| C07 | Have you changed the sowing time? | i. Yes<br>ii. No<br>iii. Don't know |
| C08 | If yes to C07, why did you change the planting time? | |
| C09 | How has variations in seasonal rainfall affected cassava yields? | 1. decreasing yields<br>2. increasing yields<br>3. no effect<br>4. Others (specify) |
| C10 | In periods of favorable weather conditions, what is the yield of cassava? | i. High **( far above normal yield per acre)**<br>**ii.** Moderately high **(just above normal yield per acre)**<br>iii. Moderate **(Normal yield per acre)**<br>**iv.** Moderately low **(just below normal yield per acer)**<br>v. Low **(Far below normal yield per acre)** |
| C11 | In periods of unfavorable weather conditions, what is the yield of cassava | i. High<br>ii. Moderately high<br>iii. Moderate<br>iv. Moderately low |
| C12 | Do changes in the planting time have any other effect on cassava apart from yield? | i. Yes<br>ii. No<br>iii. Don't know |
| C13 | If Yes to C12, Please indicate type of effect on the following | Harvesting: (eg., delayed, early, difficulty in harvesting due to drought, easy to harvest due to moist soil, etc) |



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| | | |
|---|---|---|
| | | Preservation: (eg.,hampered drying due to inadequate sunshine, increased incidence of tuber rot due to delayed harvesting, |
| | | Marketing: (eg., reduced income due smaller tuber size,..) |
| C14 | What are the typical impacts of drought or high rainfall on your agricultural activities? (Multiple responses) | 1. Crop loss<br>2. Low yield<br>3. Food shortage<br>4. Debts increases<br>5. High pest and disease on crops<br>6. Increase in labour cost<br>7. Unable to repay loans<br>8. Other, specify……………………..<br>9. Don't know |
| C15 | In what ways has seasonal variation affected your income from the proceeds of cassava? | 1. Reduced income<br>2. Increased income<br>3. No effect<br>4. Don't know |
| C16 | Where do you usually get information about the weather from? **(sources of weather information)** | i. Personal observations<br>ii. From group members<br>iii. Radio<br>iv. Television<br>v. Neighbors<br>vi. Family members<br>vii. Based on traditional knowledge<br>viii. Through Agric Extension Agents<br>ix. Don't pay attention to weather predictions<br>x. Others specify……………………………………………… |



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| | | |
|---|---|---|
| C17 | Do you own a radio set | Yes ( )<br>No ( ) |
| C18 | If No to C017, why? | |
| C19 | Do you normally share weather information with other farmers? | Yes ( )<br>No ( )<br>Don't know |
| C20 | Which gender do you think is more vulnerable to the effects of variations in the seasons and why? | i. Women<br>ii. Men<br>Reason |
| C21 | Has your standard of living been affected by seasonal variations during the past thirty year? | iii. Yes<br>iv. No<br>v. Don't know |

**Section 4: Climate Change Adaptation strategies:- This is to determine the various adaptation strategies farmers' use to lessened or neutralize the effects variations in climate**

| | | |
|---|---|---|
| A01 | Did you perform any of the following activities in response to changes in rainfall pattern? | 1. Change the cropping pattern.<br>2. Use different cassava varieties.<br>3. Increase cassava farm size.<br>4. Decrease cassava farm size.<br>5. Grow less of different kinds of crops.<br>6. Grow more of different kinds of crops.<br>7. Grow crops, which require less or more Water.<br>8. Cultivate some part of the land and leave the rest fallow.<br>9. Leave all the land fallow.<br>10. No change continued the same crops.<br>11. Migrate to cities in search of "greener pastures"<br>12. Others specify. |
| A02 | Who determines what crop to grow and when to grow? | 1. Husband<br>2. wife<br>3. both<br>4. advice by MoFA AEAs<br>5. others, (specify) |
| A03 | What factors influence the decision to grow different crops or change the cropping pattern? | 1. rainfall<br>2. drought<br>3. water availability |



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| | | |
|---|---|---|
| | | 4. land fertility<br>5. market demand<br>6. availability and access to seeds and fertilizer<br>7. suitability of crops with high yielding potential<br>8. advice from MoFA officials or meteorological service department<br>9. Others, specify ………………<br>10. I don’t know |
| A04 | What do you do in years of unfavorable weather conditions? | 1. Migrate<br>2. Go for wage labour work other than farming<br>3. Do other kinds of work (Specify)<br>4. Take a loan to invest into other non-farm business<br>5. Others (explain) |
| A05 | What strategies do you usually adapt to counter or lessen the effect of changing climatic conditions over the years? | 1. Use of early maturing cassava varieties<br>2. Changes in planting periods<br>3. Intercropping cassava with other crops<br>4. Use of fertilizer<br>5. Use of drought tolerant varieties<br>6. Increase in farm size<br>7. Practice mixed farming<br>8. Diversify into non farming business venture<br>9. Take a loan from a financial institution<br>10. Others (explain) |

**Section 5: Income and Loans:- This is to determine the effects of climate variation of the incomes of farmers’**

| | | |
|---|---|---|
| IN01 | How much income do you get from selling cassava produce in periods of favourable weather conditions in a year? | 1. Under GHc100<br>2. GHc100-GHc1900<br>3. GHc2000GHc2900<br>4. CHc3000-GHc2900<br>5. CHc3000-GHc3900<br>6. Over GHc4000 |
| IN02 | How much income do you get from selling cassava produce in periods of unfavourable weather conditions in a year? | 1. Under GHc100<br>2. GHc100-GHc1900<br>3. GHc2000GHc2900<br>4. CHc3000-GHc2900<br>5. CHc3000-GHc3900 |



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| | | |
|---|---|---|
| | | 6. Over GHc4000 |
| IN03 | Does the income from selling what you produce on your farm vary from year to year? | 1. Yes<br>2. No<br>3. Don't know |
| IN04 | If yes to IN03, what is the cause of the variation in income | 1. Prices<br>2. Weather<br>3. Labour |
| **Section 6: Institutional Support** | | |
| IS01 | Do you get any support or benefits from government agencies? | i. Yes<br>**ii.** no<br>**iii.** don't know |
| IS02 | If yes, what are the supports or benefits that you get from government agencies? | 1. Information and suggestions regarding agricultural practices<br>2. Fertilizer subsidies<br>3. Certified improved seeds<br>4. Information on climate change and adaptation<br>5. AEA support<br>6. Loans or credits<br>7. Others, specify……………………….. |
| IS03 | Which government agencies or department do you get support from? | 1. MOFA<br>2. ADB<br>3. Meteorological service<br>4. GIDA<br>5. Ministry of Fisheries<br>6. Veterinary service<br>7. Ghana Health services<br>8. Others, specify………………………<br>9. Do not get information from any gov. agency<br>10. District Assemblies |
| IS04 | As a farmer, what kind of support do you want or expect? | 1. Timely information and suggestion regarding agricultural practices<br>2. Timely subsidies for fertilizers, seeds, and other farming inputs<br>3. Timely Loans or credits<br>4. Others, specify…………………….. |



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**Group Discussion Tool**

The following will be used to facilitate focus group discussions with separate groups of men and women. The tool is designed according to a specific objectives of the study in English and carried out in the local language, "Fante" where necessary.

**General issues**

***Community resources map***

i. *To help learn about Bawjiase community and its resource-base. This will be useful in getting information about the resources and opportunities in the community and alternative livelihoods available for cassava farmers in the face of climate variation.*

ii. *Aid in the documentation of underlining gender issues involved in the distribution of resources in the community*

***The* Map may include some or all of the following**

- infrastructure (roads, houses, buildings);
- water sites and sources (drinking water, water bodies, irrigation sources, rivers, plus entitlement and utilization);
- agricultural lands (crop varieties and location);
- agro-ecological zones (soils, slopes, elevations);
- forest lands;
- shops, markets, small industries;
- special use places (bus stops, cemeteries, shrines).

***Guiding questions***

- What resources are in ample supply, which ones are in shortage? Which resources are used by men and women cassava farmers? Which are degrading or improving?
- What are the causes for depleting/degrading resources?
- Are cassava farmers switching to other forms of livelihoods as a result of depleting resources suitable for cassava cultivation? What are the gender dimensions involved?
- Does the village have land that is held in common? Who decides how common resources will be used, women or men?
- Are there any cultural practices that determine men and women's roles in the household or the community as whole?
- Do women participate in the decision-making process?
- Are the rights of access to resources different for women and men or for people from different ethnic or other socio-economic groups?



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- Are there any conflicts over resources? Why? Who is more affected by these conflicts?
  (Differentiate different gender groups).
  What are the educational preferences in terms of boy child and girl child and why?

***Seasonal Calendar Past and Present:***
**To describe the farmers' perceptions of seasonal climate parameters such as typical rainfall amounts and timing as well as average seasonal temperatures over the last forty years at regular intervals of 10 years.** The entire year would be discussed, rather than the growing season, as events over the course of the year impact each other. This will allow for a discussion of the linkages between climate variability and specific key activities and resources that occur or are available at different points during the year. The tool will be used to determine whether workloads have shifted from one season to another compared to previous years by inquiring whether the seasonal calendar has changed over time.

| | *Jan* | *Feb* | *Mar* | *Apr* | *May* | *Jun* | *Jul* | *Aug* | *Sep* | *Oct* | *Nov* | *Dec* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Rainfall* | | | | | | | | | | | | |
| *Temp-erature* | | | | | | | | | | | | |
| *Agric labour* | | | | | | | | | | | | |
| *Off-farm Labour* | | | | | | | | | | | | |
| *Food Availability* | | | | | | | | | | | | |
| *Water Availability* | | | | | | | | | | | | |
| *Human Diseases* | | | | | | | | | | | | |
| *Crop Diseases* | | | | | | | | | | | | |



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***Guiding Questions***

- What are the livelihood opportunities available apart from crop cultivation?
- Are the overall livelihood systems fairly stable or with great seasonal variations?
- How do women's calendars compare with men's? What are the busiest periods for women? For men? For youths? (are farmers having to sacrifice the school attendance of their children due to variation)?
- Which resources are controlled by women? Which resources are controlled by men? (this measures which gender is more affected by climate change impacts).
- How does food availability vary over the year? Are there periods of hunger? Does this differ for men and women? What are the underlining courses of these variation?
- How does income vary over the year? Are there periods of no income? (effects of climate variation from a gender perspective)
- How do expenditures vary over the year? Are there periods of great expense (e.g. school fees, food purchases, lobour cost)? Do women and men agree on this? Who decides on these?
- Have the seasonal calendars changed over time? (e.g. does planting, sowing or harvesting start earlier or later than previously). Has the period with the biggest workload moved forward or backward or stagnant?
- Which spouse makes decision on what crops to grow?

**Objective 1: Explore the;**

a. gender perceptions on the causes of climate variation among cassava farmers in the Awutu Senya district;
b. gender perceptions of the effects of climate variation on cassava production in the study area;

*Time* ***Line, Trend Analysis and Opinions about causes of trends***

*To document observable changes in temperature and rainfall of male and female cassava farmers from 1984 to 2014 and their opinions about causes of these trends over the past three decades.*

**Guiding questions**

- What are the temperature and rainfall distribution from the years 1984 to 2014?
- Is planting time for cassava in each farming season consistent or variable over the 30 year period?
- What is responsible the observed trend over the period?



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- Are the durations of the rainy and dry period consistent or variable?

**Objective 2 and 3:**

1. **Explore the gender dimension of the factors influencing vulnerability to the adverse effects of climate variation**
2. **Identify the more vulnerable gender to the adverse effects of climate variation**

iii. *To document the level of exposure by cassava farmers to risks of climate variations and the factors responsible the level of vulnerability from a gender perspectives in order to bring to the fore the gender dimension involved in the vulnerability to climate variation by cassava farmers in the study area and hence identify the more vulnerable gender to climate variation.*

**Guiding question**

- What are the kind of risks to farm production associated with climatic elements especially temperature and rainfall?
- To what extent are women vulnerable to these risks as opposed to men (low, medium, high levels of risk perception)?
- Which gender has the capacity minimize these risks?
- Why is one gender more vulnerable than the other if any at all?
- What are gender bias factors that enhances vulnerability to climate variation
- Which gender has more access to services such as agricultural extension, financial and/or services and how have these services helped you manage risk and ensure access to food?
- Do women have secure land tenure as men, and how has access to land affected vulnerability?
- Are they able to predict the weather correctly?
- Do they have access to sources of weather information to help predict the weather?
- Which gender has more access to reliable weather information (eg. Radio, television, assistance from MoFA and GMet)
- Do farmers use crop diversification as a means of reducing their vulnerability to climate variation?
- Which gender is able to use crop diversification vulnerability reducing strategy more efficiently and why?

**Youth.**

- How are the youth involved in cassava farming
- How are they able to overcome the challenges of climate variation



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- Are there any programmes in the area that support the youth in agriculture?

**Capacity and vulnerability analysis matrix:**

i. *To document the capacities and vulnerabilities of different groups in the target population to the impacts of climate variation.*
ii. *To make clear women's and men's roles in decision-making, their access to and control of resources and social systems of exchange in the community.*
iii. *Understand the resources and needs of men and women so as to develop long-term plan to address underlying population vulnerabilities and maximize local capacities.*

**Capacity and vulnerability analysis matrix**

| | Capacities | | | | Vulnerabilities | | | |
|---|---|---|---|---|---|---|---|---|
| | Men | Women | Boys | Girls | Men | Women | Boys | Girls |
| Material Resources | | | | | | | | |
| Social and Organizational Institutions | | | | | | | | |
| Motivation and Attitude | | | | | | | | |

**Objective 4: Identify the gender dimensions to the effects of climate variation**

i. *To record the farmers' experiences of how climate variation is affecting cassava production in the study area.*
ii. *Document how each gender is differently affected by climate variations and why*



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**Guiding questions**

- What are some of the climate variation related effects identified by farmers to be affecting cassava production?
- Who, women, men, girls, boys or all, is affected when there is less rainfall, flooding, drought, wildfires, and storms?
- How are they affected?
- Is there any specific time of the season that farmers usually assign for planting and harvesting of cassava?
- What are the gender dimensions involved in the effects of climate variation on cassava farmers?
- What are the underlining gender issues that makes one gender more vulnerable to the effects?
- Who has easy access to credit that lessen the effect of impact?
- Is there anyone – a person or an organization – that one gets help as a farmer when affected by climate variation?
- How are other members of your household affected?

  ***Food Security Annual Calendar:***

  *To show the availability, access and distribution of food within the household as well as the community over the course of 30 year period to examine climate-related factors influencing food access from a gender perspective*

**Guiding questions**

- What are the major agriculture activities of men and women (e.g. crop production, sowing, harvesting, ploughing, fishing, wood harvesting, livestock production, processing etc.)?
- In which years were the highest crop yields recorded over the past 30years?
- In which years were the lowest crop yields recorded over the past 30 years?
- What are the yields of cassava for the past 30 years compared to other crops?

**Objective 5. Identify the coping and adaptation strategies employed by each gender.**

A. *To record the farmers' perceptions of cause and effect of climate variation event, as well as the response mechanism adopted to the impacts of climate variation on cassava production.*
B. *To document the differences in the response mechanisms used by gender*



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*groups to alleviate the effects of climate variation on cassava production and why the differences.*

**Guiding questions:**

- What kinds of adjustments do cassava farmers make, including household responsibilities and work on the farm to mitigate the adverse effect of changing climatic conditions
- Which are the gender bias coping and adaptation strategies used by farmers
- Why the difference in preference?
- Are there farming practices that improves cassava yields even in periods of less or more rainfall?
- If yes, where is the source of your information and do you apply these practices?
- Are farmers aware of institutions with climate variation interventions?



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