

UNIVERSITY OF GHANA

COLLEGE OF HUMANITIES

**SPATIAL AND GENDERED DYNAMICS OF IN-SITU ADAPTATION
STRATEGIES AND MIGRATION IN RELATION TO CLIMATE
CHANGE/VARIABILITY IN THE YILO KROBO AND WA WEST DISTRICTS OF
GHANA**

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DECLARATION

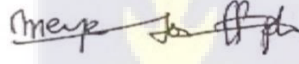
I, Shelta Gatsey, hereby declare that I am the sole author of this work, which was undertaken under the joint supervision of Professors Joseph Teye, Joseph Awetori Yaro and Doctor Nauja Kleist. All secondary sources in the work have been duly acknowledged.


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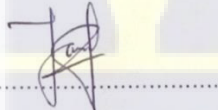
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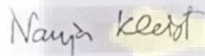
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DEDICATION

This work is dedicated to God.



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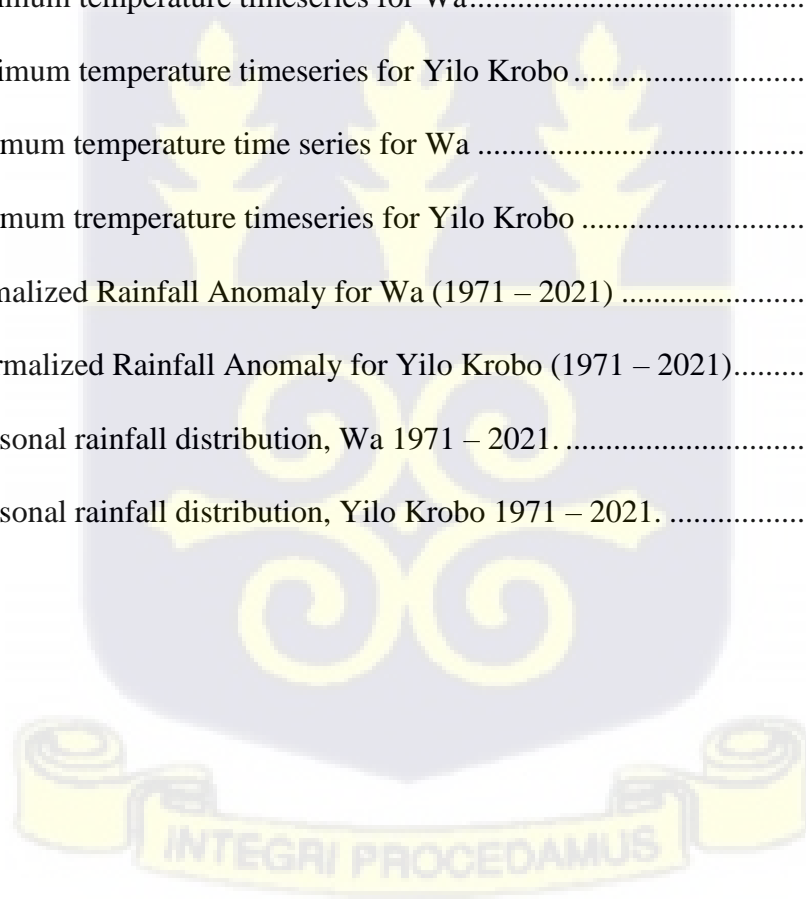
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LIST OF ACRONYMS

BBS-	Bacterial Black Spot
CSA-	Climate Smart Agriculture
CSOs-	Civic Society Organizations
DCE-	District Chief Executive
ECOWAS-	Economic Communities of West Africa
EPA-	Environmental Protection Agency
FAO-	Food and Agriculture Organisation
GAIP-	GHANA AGRICULTURE INSURANCE POOL
GMet-	Ghana Metrological Agency
GSS-	Ghana Statistical Service
JHS-	Junior High School
IPCC-	Intergovernmental Panel on Climate Change
MCEs-	Municipal Chief Executives
MESTI-	Ministry of Environment, Science Technology and Innovation
MLGRD-	Ministry of Local Government and Rural Development
MoFA-	Ministry of Food and Agriculture

NAFCO-	National Food Buffer Stock Company
NCCC-	National Climate Change Committee
SHS-	Senior High School
SPSS-	Statistical Package for the Social Sciences
UNFCCC-	United Nations Framework Convention on Climate Change
WGII-	Working Group II



ABSTRACT

Climate change has in recent years attracted the attention of many governments and development agencies. Earlier climate change studies in Ghana have often focused on the direct relationship between climate change and migration. Many of these studies have focused on the Northern Savannah zone of the country because of its harsh and semi-arid weather conditions. Nevertheless, scientific data from the Ghana Metrological Agency (GMet) suggest that places like the Yilo Krobo district in the Forest zone also experience the effects of climate change. In light of this, the study examines the spatial and gendered dynamics of climate related migration and in-situ adaptation strategies in the Wa West district located in the Northern Savannah zone and the Yilo Krobo located in the forest zone. The study of these two areas located in two diverse ecological zones of Ghana enabled the adequate assessment of the spatial dynamics of the climate-adaptive strategy of various social groups. To achieve its objective, the study employed the sequential explanatory mixed methods research design for the data collection and analysis. Using the simple random sampling method and the 1967 Yamane formula, the study derived a total of 469 respondents across the two districts. The structuration theory was employed to demonstrate how structures either enabled or constrained farmers' adaptation strategies and how farmers overcame some of these constraints. The entitlement framework enhanced our understanding of how men and women farmers' access to resources affects the type of adaptation strategies adopted. Additionally, the foresight framework was used to explain how the effects of climate change interact with other factors to inform climate (im)mobility. Results from the study showed that both genders perceive changes in temperature as well as rainfall patterns and distributions. Such changes and awareness of the climate change effect on farm yields, prompt farmers to adopt certain adaptation strategies. The study further demonstrated that there were significant gendered and spatial dynamics in the adoption of in-situ adaptation strategies. Additionally, most households across districts used migration as an adaptation strategy. Though both men and women across districts migrated, their motivations and patterns were dissimilar. Further analysis indicate that both men and women were probable to experience climate immobility, however the causes varied. The study contributes to the already existing literature on climate change, gender and migration in Ghana, particularly in the Yilo Krobo and Wa West districts. It accentuates the need for a context-specific spatio-gender responsive approach to climate change adaptation and migration policies,

by acknowledging the varying vulnerabilities and challenges experienced by various social groups in different agro-ecological zones. It is imperative therefore, that policy makers, researchers as well as development agencies design spatio-gender inclusive strategies to address climate change impacts and promote sustainable development.



CHAPTER ONE

BACKGROUND OF THE STUDY

1.1 Introduction

Climate change presents a global developmental challenge (Foresight, 2011; Mbiyozo, 2020), which has attracted the attention of many governments and development partners in recent years (Abdullahii, 2020). Much of the recent changes in temperature and rainfall regimes have been attributed to the emission of greenhouse gases, which continues to rise despite concerns being raised by environmentalists and some development practitioners (Conway et al., 2019). According to Le Quéré et al. (2018), there has been a 2.7% increase in global carbon emissions in the 21st century.

There is an overwhelming load of scientific evidence and data, suggesting that climate change is largely human induced (Adger et al., 2015). This is seen in the atmospheric concentration of carbon dioxide which has increased from a preindustrial revolution value of 278 parts per million to 387 parts per million in 2008 (Asane-Otoo, 2015). Work by climate change experts, such as, MacIsaac (2019) reveals that since the industrial revolution, annual variations in the concentration of carbon dioxide has seen a tremendous increase. Projections from IPCC (2018), forecasts that global warming will result in changes in precipitation patterns, acidification, and humidity. Available data, such as Pitman et al. (2015) shows that the effects of climate change on population displacement are significant. Hence, such predictions from IPCC (2018) make it overwhelmingly difficult to determine the intensity as well as, how widespread the effects of climate change will be on the human environment and the very structure the society has been built upon. According to Gemenne (2011) for over a decade, about 20 million people have been displaced due to extreme

weather events. There are projections that this number will increase to about 200 million environmental migrants by 2050 (Mueller et al., 2020). As pointed earlier, it is difficult to pinpoint the exact effect climate change has on the human environment. This is primarily because, there is little to no correlation between a place's contribution to climate change and the effects it experiences (Thomas et al., 2019). Practically, these spatial disparities in climate change effects on the human environment could be related to the inadequacy of the adaptation strategies the people adopt to address the effects of climate change (Biesbroek et al., 2010).

For example, Africa's contribution to global climate change is very minimal, yet, the continent has been the worst affected by the effects of climate change (Onwutuebe, 2019). Farming communities in the dry and poor regions of Africa are affected by increasing temperature and fluctuating rainfall patterns because they depend on rain-fed agriculture (Athula & Scarborough, 2011). This has led to a rise in crop failure, food insecurity, poverty, and population mobility in the arid and semi-arid regions of Africa, including Ghana (Shukla et al., 2018). A reason for climate change dire effects on the continent is its weak adaptive capacity in the adoption of adaptation strategies as a result of some factors like, poor governance, poverty, political instability, high rise in population as well as inadequate infrastructure (Ojo & Baiyegunhi, 2020).

Admittedly, most early efforts to deal with climate change in Africa focused extensively on mitigation measures to reduce the emission of greenhouse gases (Mbow et al., 2014). However, recent realization in academic circles and among development agencies shows that climate change is inevitable due to reasons like rising population and the complicated nuances associated with the effects of climate change on human development (Brown & Westaway, 2011). This has promoted the need to develop effective climate adaptation programmes on the continent (Mbah et al., 2021).

In Ghana and elsewhere in Africa, the common in-situ adaptation strategies adopted by farmers to deal with climate change include irrigation, integration of livestock production, mixed cropping, application of fertiliser on farms, and shift from agriculture to and non-farm jobs (Afriyie-Kraft et al., 2020). The adoption of these strategies is dependent on a host of factors including the farmers' adaptive capacity and their perception of climate change and its effects (Addaney et al., 2021).

Conversely, climate change perception is a highly contested concept due to the lack of scientific tools to measure the farmers' perception (Van Valkengoed et al., 2021). This is because, perception relies on farmers' past memories to measure the atmospheric conditions as well as the farmers' reliance on short term experiences in order to recount and respond to climate-related questions (Libarkin et al., 2018). Nevertheless, these factors do not overshadow the very need to take into consideration the importance of climate change perception in the adoption of adaptation strategies. Despite the idea of climate change perception being dependent on subjective assessment, there is still the need for one to perceive climate change before adapting to a strategy (Van der Linden, 2017). Consequently, one can only expect an effective adaptation if the perception tallies with scientific findings and if the adaptive capacity of farmers is enforced.

In this case, adaptive capacity constitutes how local farmers have access to resources (Abdul-Razak & Kruse, 2017) in order to cope with identified external stressors (Ahmed et al., 2016). Contrary, access to resources is dependent on social, economic, cultural and political factors (Akinagbe & Irohibe, 2014). In some instances, access to these resources is dependent on how government institutions distribute in some spaces. For example, in Ghana, although climate data suggest that climate change occurs in places like the Coastal Savannah Zone (Teye & Owusu, 2015) and the Tropical Forest Zone (Gravesen et al., 2020), anecdotal evidence and limited data point out that climate change interventions and resources often focus on the Northern Savannah

Zone due to the harsh weather conditions and high poverty rate. In addition, some social groups have their adaptive capacity either constrained or enabled by government structures, social, cultural and in some case economic structures. In works such as Alhassan et al. (2018), it was noted that women in rural areas are more prone to the effects of climate change due to assigned social roles. This includes gender-based cultural norms, which encourage a gender-based division of labour within households (Rao et al., 2017), like the collection of firewood, water fetching, childcare, sweeping, garbage disposal and cooking, as well as the reproduction of social relations in the household and the community (Matewos, 2019). These responsibilities together with other economic constraints prevent women farmers from effectively adopting certain strategies to adapt to the effects of climate change (Babacan, 2021). Comparatively, the men engage in both food and cash crop cultivation on a large scale. They are also able to have access to financial resources; this is because they are often in charge of the monetary aspects of farm sales (Dankelman, 2010). Without the burden of household chores and the advantage of traditional gender norms (MacGregor, 2010), male farmers are more likely to acquire farm inputs, and thus finding it easier to adopt an adaptation strategy as compared to their female counterparts.

Correspondingly, some patriarchal norms like traditional land inheritance systems equally inform the adaptive capacity of each gender (Manzanera-Ruiz et al., 2016). For example, in comparison with men, women in Ghana and Africa in general have less access to land (Akaateba, 2019). In instances, where women can own land, it is affiliated to factors like class, social and marital status (Antwi-Agyei & Nyantakyi-Frimpong, 2021). In addition, in most cases, it is cultivated under the supervision of a male partner (Kuusaana et al., 2013). According to Akaateba (2019), women in most cultures generally have rights to cultivate and sell crops however not rights to allocate land.

As a result, of such cultural constraint, women are less likely to adopt strategies like irrigation (Assan et al., 2018).

Additionally, social groups like the youth and elderly sometimes have their adaptive capacity enabled or constrained (Scott-Parker & Kumar, 2018). In Yaro et al. (2016), it was indicated that the youth are more likely to adopt strategies like off-farm jobs due to their strength, whereas the elderly were limited in their options. On the other hand, some factors like education are more likely to influence the adaptive capacity of some farmers who are more likely to adopt a strategy like a civil job (Akinyi et al., 2021), or even the capacity to migrate due to the possession of the required skillset and basic understanding of arithmetic and reading (Nguyen et al., 2019). Regardless, some farmers choose to migrate or send away some household members who can support the household with remittances (Dustmann & Glitz, 2011).

Migration as an act has been a part of the lives of many people for centuries for now (Borderon et al., 2019). It has overtime evolved to become a major climate adaption strategy (Becerra-Valbuena & Millock, 2021). It is often a collective decision that is formed by household members in order to diversify their income (Nguyen et al., 2019). Migration as an adaptation strategy has emerged as a concept that challenges the notion of migrants being merely climate victims (Azumah & Ahmed, 2023). It does this by pointing out the distinctions between migrants and structures such as (social, cultural, economic, political) and human agency (Ayamga et al., 2019). It further shows how migration collectively builds the adaptive capacity of households through remittances or weakens the adaptive capacity of the household as a result of a loss of labour (Jha et al., 2015). Nonetheless, there are gendered differentials in adopting migration as an adaptation strategy (Rothe, 2017).

Despite the nuances pointed out above, the literature on the spatial and gender disparities of climate change perception, adaptation strategies and climate-related migration across agro-ecological zones in Ghana have not been adequately considered. Nonetheless, this thesis is a part of the Governing Climate Mobility project funded by DANIDA. Consequently, the study areas have been preselected by the project team. However, the researcher will provide justification for these study areas in subsequent sections and chapters of the thesis

In furtherance of this, the thesis, therefore, seeks to examine the spatial and gendered dynamics of adaptation strategies and climate related (im)mobility in the Wa West and Yilo Krobo districts of Ghana.

1.2 Problem Statement

In many African countries, climate change and climate variability have brought several exposure-sensitivities on different people (Mpandeli et al., 2020; Tahiru et al., 2019). For example, in Ghana, there are occurrences of rapid onset environmental events, such as flooding, as well as slow-onset processes, especially rising temperatures, and declining rainfall and these affect various social groups, like the poor, women and children (Asante et al., 2021). Available data show that, since 1960, the mean annual temperature in the country has risen by 1.0°C (Gravesen et al., 2020) and it is further projected to rise by 2.0 C in 2050 (Djido et al., 2021). Similarly, rainfall amount has declined by 20% since 1960, and it is further projected to decline between 9% and 27% by 2100 (EPA, 2020).

While much of the discussion on climate change and variability in Ghana focuses on the Northern Savannah zone, which lies in a semi-arid region, available data show that some areas in the forest zone, especially the Yilo Krobo district also face climate change and variability (Gravesen et al.,

2020). The Wa West district, which is one of the preselected areas for this study, experiences a single-peak rainfall regime and a long dry season which in turn affects the district's agricultural productivity. The district is considered to be the poorest in Ghana (Ghana Statistical Service, 2021), with about 70% of its population being poor. The high incidence of poverty in the district can be attributed to its location in a harsh zone and its reliance on rain-fed agriculture, which necessitates that local farmers depend on in-situ adaptation strategies to sustain their agricultural livelihoods (Amoah, 2019; Antwi et al., 2015; Kusakari 2014). However, factors such as limited access to information and resources, financial constraints, and inadequate infrastructure support influence farmers' decisions to adopt certain strategies. In addition, certain socio-cultural factors such as traditional inheritance norms may also inform the type of strategies adopted by farmer. Additionally, due to inadequate employment opportunities and high level of poverty, the district has experienced massive out-migration over the years (Baada et al., 2019). Traditionally, males from the region dominate migration streams and many of the migrants move internally to other parts of the country, especially the Brong Ahafo region where they work as farm labourers (Sward, 2017). Recent data, however, show that more girls and women are also migrating independently to southern Ghana, because of economic hardship partly caused by climate change and variability (Awumbila, 2015). Adaptation literature Adger (2016), Huq (2018) and Warner (2019) argues that the adoption of in-situ adaptation strategies discourages migration. However, this study posits that migration itself is an adaptation strategy and, in some cases, is used to support the adoption of in-situ adaptation strategies

The Yilo district has also been selected for this study because it is one of the areas in the forest zones that experiences climate variability. While the district experiences a double rainfall maximum, fluctuations in rainfall have been recorded in recent years (Abbam et al., 2018). The

fluctuation of rainfall has led to the emergence of pests and diseases, resulting in a decline in crop productivity in the zone. This decline affects agricultural productivity and, consequently, the effects of climate change on farmers' agricultural productivity further influence their migration to urban areas.

As mentioned earlier, there are differences in the abilities of different social groups to adopt in-situ adaptation strategies and migration to deal with climate change (Castles, 2011). In most cases, patriarchal norms make it difficult for women to adopt certain adaptation strategies or to migrate (Awumbila, 2015; Bessah et al., 2021). In relation to migration, anecdotal evidence suggests that some social groups are unable to migrate due to a lack of resources and other barriers created by the interaction of social, cultural, political, and economic structures. There is little understanding of climate immobility in Ghana, primarily due to inadequate data capturing the scale and scope of climate-related immobility within the country. Most existing data is often anecdotal and based on small-scale studies, which hinders a comprehensive view of migration patterns in Ghana. Additionally, there is limited understanding of the drivers of climate immobility. While economic factors are often cited in migration literature as reasons for climate-related (im)mobility, Boas et al. (2018) demonstrate that cultural, social, and personal factors also play significant roles in influencing individuals' decisions to stay rather than move.

In relation to the study areas, although the literature show that the effects of environmental change on livelihoods are often gendered, including differential reaffirmation of women's and men's roles, and power relations (Jamal et al., 2023; Setrana & Kleist 2022), there is also very little attempt to examine gendered dynamics of climate-related migration in Ghana, particularly in the forest zone. These gaps are created by the fact that many of the early studies on climate change in Ghana largely focused on the effects of climate change and adaptation strategies in the Northern Savannah Zone

(e.g., Bawakyillenuo et al., 2016; Yaro et al., 2016), thus, neglecting pertinent issues such as the role of climate change perception on adaptation strategies, the gendered dynamics of adaptation strategies as well as the nature of climate-related migration in areas like the Forest Zone.

Furthermore, there have been inadequate studies on the spatial dynamics of in-situ adaptation strategies and climate-related migration across two distinct agro-ecological zones of Ghana. It is imperative for researchers and policymakers to understand how different social groups across various regions adopt in-situ adaptation strategies and the nature of climate-related (im)mobility in these areas. Such understanding can contribute to effective policy recommendations and interventions. For instance, by identifying areas where adaptation strategies are likely to be effective and where climate-related (im)mobility is likely to occur, particular targeted interventions can be developed to address the specific needs of different areas and social groups.

On this premise, the study seeks to examine the spatial and gendered dynamics of climate adaptation strategies and climate-related (im)mobility in the Wa West and Yilo Krobo districts of Ghana.

1.3 Broad objective

The broad objective of this study is to examine the spatial and gendered dynamics of climate adaptive capacity and climate related im(mobility) in Ghana with specific reference to the Upper West and Eastern Regions.



1.4 Specific Research Objectives

Specifically, the research seeks to:

1. To assess the lived in experiences and perception of climate change in comparison with scientific data.
2. Examine the spatial and gendered dynamics of in-situ climate adaptation strategies being adopted by farmers in the Upper West and Eastern Regions
3. Explore the gendered dynamics of climate-related migration trajectories in the Upper West and Eastern regions
4. Assess the gendered differences of climate immobility in the study areas.

1.5 Research Questions

The research seeks to address the following questions:

1. Are local people's perceptions of climate change consistent with scientific data?
2. Are there gendered and spatial differentials in the capacity of farmers to adopt various climate adaptation strategies?
3. To what extent and how do households in the Upper West and Eastern Regions of Ghana use migration to adapt to climate change?
4. Are there gendered differences in climate-related immobility in the Upper West and Eastern Regions of Ghana?

1.6 Hypotheses

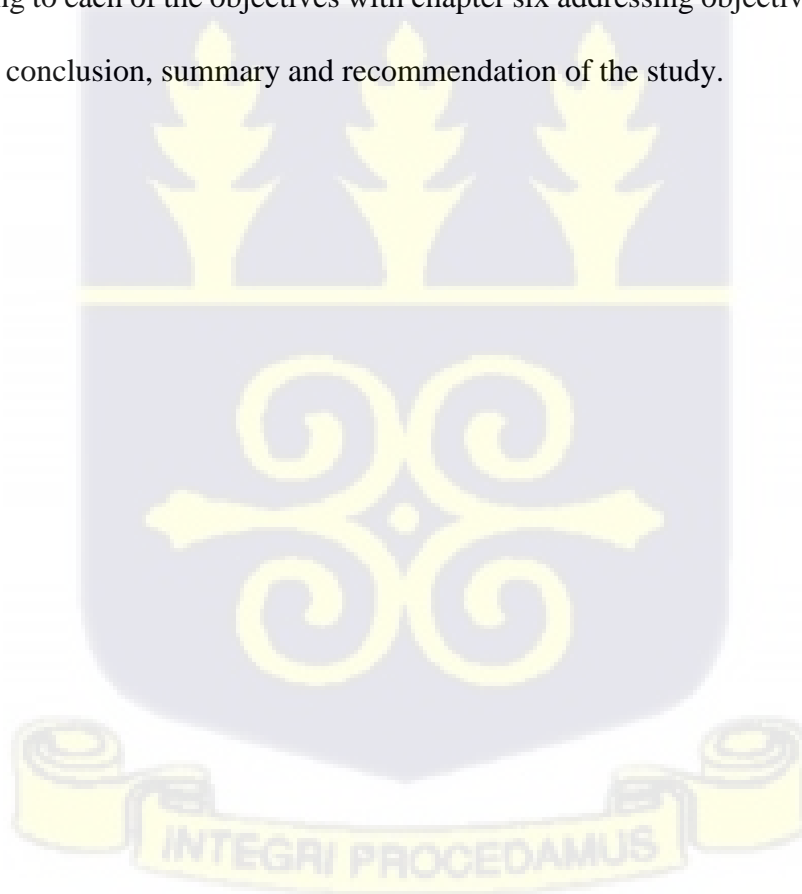
1. H_0 : There is no significant relationship between gender adoption of adaptation strategies
2. H_0 : There is a significant difference in the in-situ adaptation strategies used by farmers in the Yilo Krobo district compared to those in the Wa West district
3. H_0 : There is no significant relationship between gender and migration

1.7 Rationale of the study

Many climate change studies in Ghana focus on the direct relationships between climate change and migration (Kumasi et al., 2017). Due to harsh arid conditions, most of these studies have been focused on areas in the Northern Savannah Zone. However, available data from the Ghana Metrological service show that climate change equally occurs in the Forest zone. While there may be some studies which reflect the spatial differences in the adoption of in-situ adaptation strategies in response to climate change, very few studies highlight the gendered and spatial disparity in the adoption of these strategies. Again, most climate change studies in Ghana, do not adequately explore how social structures could constrain or facilitate the adoption of adaptation strategies of some social groups. On the other hand, there is minimal understanding on the extent that rural households across different region use migration as an adaptation strategy. There again, there are inadequate studies that have explored the gendered differences in climate immobility in Ghana. What this study seeks to do is to understand how gendered and spatial dynamics of in-situ climate change adaptation strategy and climate im (mobility) in the Upper West and Eastern Region of Ghana. The findings would contribute to efforts to the design of policies to deal with climate change taking into consideration the spatial and gendered dynamics.

1.8 Organization of the study

This thesis is organized into seven chapters. Chapter one represents an introduction to the study and outlines the problem statement. It also highlights the research questions as well as the research objectives. It further states the expected outcome of the study. Chapter two is a review of literature on climate change at the global level. The chapter also reviews literature on perceptions, adaptation strategy as well as literature on migration and climate change. The third chapter focuses on the methodology used in this study. It explains the epistemological underpinning of the study and points out the characteristics of the study area. The subsequent three chapters serve as the research findings according to each of the objectives with chapter six addressing objective 3 and 4. Chapter seven covers the conclusion, summary and recommendation of the study.



CHAPTER TWO

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORKS

2.1 Introduction

This chapter reviews theoretical and empirical literature on climate change, gender, and migration. It aims to bring to the forefront the existing links established between climate change, migration, and gender. This is done by reviewing literature on environmental and climate change/variability; climate change in Africa and Ghana; effects of climate change on land use and livelihoods in Ghana; gendered dynamics of climate change; climate change perceptions, climate change adaptation strategies, gendered dynamics of climate-related migration, and climate immobility.

2.2 Climate Change/Climate Variability

In the past two decades, climate change has become a global topical issue (Bawakyillenuo et al., 2016). The concept of climate change and what it means has equally been discussed in the academic and policy circles. As such, various definitions of this global phenomenon have emerged from various institutions and scholars. The IPCC (2018, p. 544) defines climate change as “a change in the state of the *climate* that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer.” This definition also captures ‘climate variability’, which is described as “variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the *climate* on all spatial and temporal scales beyond that of individual weather events” (IPCC, 2018). The difference between the two is the temporal signature. Climate change is observed over a long period in time, usually decades or more, but variability is often within a

short period of time. Nevertheless, climate variability, in the long-run, leads to climate change (IPCC, 2014).

The causes of climate change may be due to natural internal processes or external factors which include but not limited to modulations of the solar cycles, volcanic eruptions and/or continuous human caused changes in the structure of the atmosphere and/or land use. The United Nations Framework Convention on Climate Change (UNFCCC), in its definition of climate change, captures the human factor in the cause of climate change thereby distinguishing it from natural causes. Article 1 of UNFCCC defines climate change as, “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods” (United Nations Framework Convention on Climate Change, 1992, p. 3). Such changes are, however, often not spontaneous, but are a gradual process over time. There are however, some instances where there can be sudden events, which could be in the form of earthquakes, hurricanes, or wildfires. In the climate change literature, two major types of changes have been identified. First are ‘slow onset’ climatic processes, such as changes in temperature and rainfall. The second is rapid or sudden onset climatic events, which include tropical cyclones, and floods (see Renaud et al., 2011).

Over the years scientific data, points out that climate change has largely been caused by humans. This is evident in the heavy concentration of carbon dioxide, which has been in continual increase over the years. The last two decades have equally witnessed a rise in Greenhouse gas emission from 1.3% per annum in the 1990’s to 3.3% per annum between 2000 and 2006 (Ritchie et al., 2020). It has further been mentioned that the average temperature has increased to over 0.6 degrees Celsius in the past century. It is believed that between the years 1996 and 2005, there was a

recording of an unprecedented high rise in atmospheric temperature (UNFCCC, 2007). These were marked as the warmest years. The global mean temperatures are likely to increase between 1.4 and 5.8 °C by the turn of this century with a consistent rise in sea level as glaciers melt.

The IPCC (2018) predicts that global warming will trigger changes in precipitation patterns, acidification, and humidity. Such a prediction makes it overwhelmingly difficult to determine the intensity and how widespread the effects of climate change will be on the society and the very structure the society has been built upon (Bhattarai, 2017; Pitman et al., 2015). This makes it difficult to pinpoint the exact effect climate change has on the human environment. This is because climate change has different effects on human beings depending on their locations (Castells-Quintana et al., 2018). For example, people who depend largely on the climate are more likely to be affected negatively if favourable conditions of the climate decline (Samson et al., 2011).

2.2.1 Climate Change in Africa

Identified as third world and a developing region (Drobotya et al., 2021), Africa is considered the least contributing continent to the world's climate change plight (Thornton & Gerber, 2010). This is partly because of the limited industrialization in many African countries as compared to developed countries this has led to lower emissions from African factories and power plants. In addition, studies like point out that many African communities rely heavily on traditional energy sources like firewood, while this contributes to deforestation, it does have lower carbon footprint than fossil fuel. In 2018, for instance, Africa accounted for only 3% of global emissions (Pitman et al., 2015). It is further believed that the average carbon footprint of an African is significantly lower than what is recorded as the world's average (Asane-Otoo, 2015).

Despite Africa's minimal contribution, the continent has always been one of the most affected by climate change (Mbiyozo, 2020). This is largely due to slow development, poor governance as well as its inability to effectively utilize human resources to deal with climate related challenges (Bhatta et al., 2015). The effects of climate change on the continent are evident in the agriculture sectors and the water ecosystems. For instance, some places in Africa experience a high number of weather-related natural disasters, which greatly affect the human environment. Countries such as Mozambique in the 2010s experienced flash floods (Arnall et al., 2013), whereas places like Senegal experienced heavy mud slide (Zickgraf, 2018). These events caused a sudden displacement of people. There are other effects such as drought, which although not sudden, has a gradual effect on the human environment by affecting livelihood, health and the water ecosystem (Simalabwi, 2017). Some countries like those located in the African Sahel region experience prolonged droughts which heavily impacts agriculture and increases the risk of food insecurity (Atwoli et al., 2022).

Scholars such as Kogo et al. (2021), Oluwatayo and Ojo (2016) do agree that the adverse effects of droughts on the continent are due to the continent's overdependence on rain fed agriculture. This creates a fundamental problem in the livelihoods of most Africans. This is because agriculture contributes about 14% of the continent's GDP, yet about 98% of agriculture in the sub-region is constantly rain fed whilst employing about 52% of the sub-region's population into the sector (Arora, 2019; Messerli et al., 2019).

According to Simabalwi (2017), the economic consequences of drought or any climate-related problem is reliant on a host on other factors most of which are often political. In Africa, there are periodic political instability, and this instability can promote the negligence of governments in the presence of climate change effects like drought, which could lead to poor harvest (Malhi et al.,

2021). Most African households depend on subsistence farming, therefore a poor harvest caused by drought could be detrimental to the income level of the household (Giller et al., 2021). This could in the end breed hunger and increase the threat of food insecurity (Zieba et al., 2017).

The presence of drought in Africa also contributes to water scarcity in Africa (Fetzek & Mazo, 2014; Campbell et al., 2021) and this sometimes leads to conflict over scarce water resources. For instance, in Nagarajan et al. (2018) in their study of the Lake Chad basin, show that drought within the last 50 years has caused the lake to reduce in about 90% of its original size. As a result of this, there has been a decrease in fishes as well as continuous conflicts between neighboring countries due to overlapping interests in the use of the lake (Yunana, 2017).

Another consequence of climate change on the African landscape is on health (Byass, 2009). Climate change has led to an increase in vector borne diseases such as malaria (Ramin & McMichael, 2009). Admittedly, few studies have been done to establish the correlation between climate change and malaria (Bhattacharya et al., 2006). Written reports suggest that climate change increases the opportunity for malaria transmission in prevalent areas thereby widening its spatial range (Lynch et al., 2015). For instance, continuous dry climates with bouts of heavy rainfall provide a fertile ground for mosquitoes (Engels & Zhou, 2020). When these occur on a lower altitude, the mosquitoes tend to grow faster hereby creating a fast distribution of the disease. The above-mentioned effects as well as failure to tackle extreme poverty, weak institutions, lack of medication, and corruption, have made Africa suffer from the effects of climate change (Nagarajan et al., 2018).

According to Ziervogel et al. (2014), these effects are likely to increase and worsen. This could be expected due to the continent's current population projection. It is projected that the continent

would have over 300 million youthful populations by 2050 (World Bank, 2018). This could lead to urbanization (Lin et al., 2021). There will therefore, be the need to create a larger energy sector that will cater for the need of the rising population (Henderson et al., 2017). This further implies that, there would be an increase of industrialization on the continent with corresponding increase in the green house levels. Additionally, the current deforestation rate on the continent, in places like the Congo basin, has led to the low absorption of carbon emission on the continent (Bowler et al., 2020). This resonates the concerns of the fifth IPCC Assessment report which suggests that although the continent has low contribution rate, its temperatures for the 21st century are projected to rise faster than the current projected global average increase. It has been estimated that a vast area of Africa will experience increase temperature exceeding 2 degrees Celsius above pre-industrial levels. Such projections on the continent's relationship with climate change have propelled African countries such as Ghana to sign to international conventions such as the Paris Agreement in 2016 (Ayuk & Dovie, 2019), in order to aid in solving the global climate crisis.

Ghana, for instance, has experienced changes in rainfall and temperature patterns over the years. It currently has a high temperature with the average annual temperature ranging between 24 °C to 30 °C. Despite this, in some northern and southern part of the country, the temperature alternates between 18 °C and 40 °C (Abdul-Razak & Kruse, 2017). The country's rainfall pattern is such that it decreases from south to the North (Owusu & Waylen, 2013). Consequently, the wettest place in the country is the extreme southwest, with an annual rainfall of about 2000 mm while the annual rainfall in extreme north is less than 1100 mm (FAO, 2015). The country further has two main rainfall regimes, known as the double maxima regime and the single maximum regime. The double maxima regime constitutes two maximum periods that are from April to July and from September to November in southern Ghana. The single maxima regime is from May to October in Northern

Ghana (Owusu, 2018). While the southern part of Ghana generally experiences the double maxima rainfall regime, the northern part experiences a single maximum regime.

In Ghana, climate change is evident in the rise of temperatures and unpredictable rainfall across all ecological zones (Williams et al., 2020). In recent years, there has been unstable rainfall patterns as well as an over alarming rise in temperature (EPA, 2011). The 2010 World Bank report shows that in the 1960s, rainfall in the country was mostly high. The amount of rainfall was significantly reduced in latter end of the 1970s and the earlier end of the 1980's. Historical data together with a trend analysis by Larbi et al. (2018) shows that the country had experienced 2.3mm per annum decrease in rainfall between 1960 and 2006. The analysis further pointed out that there has been 1°C increase in temperature over 30-year period based on historical data. While northern Ghana has been the focus of much of the discussions on rising temperatures, the forest zone is also experiencing rising temperatures (Teye et al., 2021). The World Bank (2010) projected the temperature of Eastern Region to increase by 1.7°C – 2.0°C by the year 2050.

The IPCC (2013) has reported that there will be a shift in the rainfall regime in Ghana. Ghana has therefore been predicted to have a longer dry season and a vanishing wet season. This has prompted organizations and scholars alike to outline the major physical impacts of climate change in Ghana. According to Owusu (2018) there are three major physical impacts of climate change in Ghana; that is, temperature change, change in rainfall and sea level rise. These consequently affect the basic components of food production such as soil, a reliable water source. An unreliable and unstable rainfall pattern is a threat to the livelihoods of most people in the country (Athula & Scarborough, 2011). This is due to the country's reliance on rain fed agriculture (Klutse et al., 2021). The adverse effects of climate change that affect the Ghanaian economy can be attributed to the over reliance of the agriculture and energy sector on rainfall (Nkrumah et al., 2014). Dankwa

et al. (2021), attribute the adverse effects of climate change on Ghana's inability to adopt adaptive measures that will help mitigate the effects of climate change whilst catering to the needs of sectors that are sensitive to the unstable climate.

Additionally Abdul-Razak & Kruse (2017), argue that the effects of climate change/variability in Ghana is widespread in various sectors and geographical areas of the country, nonetheless the Northern part of the country is considered to be much more prone to the effects of climate change. This is as a result of its primarily agrarian economy (Bawayelaazaa et al., 2016) and its livelihood over reliance on rain-fed agriculture (Antwi-Agyei & Nyantakyi-Frimpong, 2021). The decline in rainfall as well as the continuous increase in temperatures makes that part of the country much more vulnerable to the adverse effects on climate change (Azumah et al., 2022). Furthermore, the unstable rainfall pattern as well as high temperature has a radical effect on the groundwater level. It is projected that the groundwater level in northern Ghana will decline between 30% and 40% by 2050.

The above factors make the region a good candidate for desertification. This will further affect agriculture productivity in the region. Apart from the northern savannah zone, agricultural activities in other parts of Ghana are also affected by climate change. In regions located in the forest zone, such as the Eastern Region (Amfo & Ali, 2020), declining rainfall affects agricultural activities. As previously established, smallholder farmers dominate the agriculture space. Yet 70% of these farmers cultivate a farmland of less than three hectares. This leads to an increase in the pressure on land use. Coupled with the already effects of climate change, farmers are steadily producing food below optimal level. For instance, maize is a global staple food and has an increasing domestic demand. Yet, according, MOFA (2011), as of 2011, the supply of maize in

Ghana had fallen short by 11%. This subsequently breeds food insecurity and instability in the economy.

2.3 Gendered Effects of Climate Change

The literature suggests that women are much more susceptible to the impacts of climate change (Awumbila et al., 2014). The fact that women are affected more by the climate change is attributable to social structures such as rules on inheritance and gender-based norms like household responsibilities (Carr & Thompson, 2014). For instance, due to gender-based cultural norms a gender-based division of labour is often promoted within households (Ampaire et al., 2019). In most cases, the jobs the women partake in are unpaid ones because they are usually for the wellbeing of the household (Ekejiuba, 2020). These jobs include water-fetching, collection of firewood, sweeping, childcare, cooking, as well as the reproduction responsibilities (Annan et al., 2021).

The 2015 United Nations Economic Commission for Africa reports that Ghanaian women spend more than two times as much time on domestic work as men do. This is common among women in the rural areas of Ghana (Awumbila, 2015). These rural women usually engage in the crop production and the small-scale trading of agriculture produce (Lama et al., 2021). However, the men are often involved in both food and cash crop cultivation on a large scale and in some cases they are in charge of the monetary aspect of farm sales (MacGregor, 2010).

According to Yoking and Lambrecht (2020) women cultivate almost forty percent of land in Ghana. This notwithstanding, Kumeh and Omulo (2019) are of the view that women in Africa have lesser land acquisition rights as compared with their male counterparts. This is likely due to societal principles that place emphasis on the gender of a person, the class of a woman, her social

and marital status in determining her land acquisition rights (Brixiova et al., 2020). There are instances where women can own land; however, this is under the authorisation of a male figure head or a partner (Djurfeldt, 2020). Hence, women's right to use this land is pre-determined by their relations to men such as mothers, wives, sisters and daughters (Akaateba, 2019; Der Bebelleh, 2021)

Though studies like Udry (2011) points to the existence of an already existing land tenure insecurity in Africa, women in rural areas are more likely to be at a greater risk because of the patriarchal system set up that deprives them of the rights to access, own, control or inherit land and property (Glazebrook et al., 2020). There are occasions, where women have communal rights to land, yet they lose those rights when they move to another village due to marriage or when they are widowed (Azechum, 2017). This makes them dependent on their husbands or male relatives. While women access to land is increasing because of certain discriminatory practices gradually being challenged and changed (Semazzi & Kakungulu, 2020), they are yet to fully occupy spaces in land and farm management decision or gain access to credit after death of the husband or when the husband is away (Bawa & Sanyare, 2013; Olawuni et al., 2022).

Considering the above illustrations, the effects of climate change tend to widen the already existing gender disparity between men and women (Eastin, 2018). Gender bond roles assigned to women in rural areas makes them more susceptible to climate change (Djoudi et al., 2016). Their roles as the primary care givers is embodied in the roles of food producers and providers, guardians of health, care givers, and economic actors (Dankelman, 2010), this increases their workload outside their households. This is because certain effects of climate change such as unstable rainfall, series of droughts as well as deforestation increases the workload of women to sustain livelihood (Codjoe & Owusu, 2011; Fagariba et al., 2018). Women must therefore, work extra hard to earn an income

when crop cultivation fails (De Pinto et al., 2020). This is particularly much more strenuous for female-headed households (Alhassan et al., 2019), thereby making it precarious for the household to navigate through the effects of climate change. Additionally, most women in rural areas have not been adequately trained to acquire a life skill outside the home and farm (Fagariba et al., 2018). This makes the transition from a farm job to a non-farm job very difficult (Nuhu & Matsui, 2022). They are also often prevented from securing jobs outside farming because of the need to partake in household duties (Antwi-Agyei & Nyantakyi-Frimpong, 2021). In some instances, girls have to drop out of school to help their mothers to gather wood and water (Dampney & Essel, 2014). Furthermore, the exhaustion of natural resources, like the depletion in water bodies as well as the poor returns on agricultural productivity places additional burdens on women's health. This is because in most traditional areas, the provision of water is mainly the responsibility of women and girls (Dzah, 2011). The search for water leads women to walk for long miles in order to have access to some water (Wrigley-Asante & Agandin, 2015). In the event of droughts and water shortages, women must walk for longer distances to access water for home use. There are cases where the water is unsafe for drinking and these results in breakout of illnesses like cholera, diarrhea, malaria, malnutrition, and heat related deaths. Sometimes, pregnant women lose their babies because of the stress load or maternal anemia (Hadley et al., 2023).

In Ghana, women face inequalities regarding education, control and access to land, technology, decision-making power, and financial and other productive resources (Ankrah et al., 2020; Quaye et al., 2019). These inequalities are borne out of dominant cultural norms and permissible and governing barriers (Dery, 2016). Women's illiteracy rate is at 30% compared to 17% of men (Abudu et al., 2013). In addition, the gendered divisions of labor in society tend to affect women a lot more (Pueyo & Maestre, 2019), by enforcing women to spend majority of their time in unpaid,

time consuming, productive activities such as collecting firewood or water, instead of in market-valued productive activities (Assan et al., 2018).

Consequently, women in Ghana are more likely to be impoverished than men, a situation that is triggered by several societal factors such as traditional gender norms, which in turn leads to the poor participation in policy-making and implementation (Amoah, 2019). Thus, women in Ghana are less likely to be well equipped to adapt to climate change impacts (Assan et al., 2018). Despite this, women are powerful agents of change due to their important role in Ghana's relevant sectors for development and climate change - energy and agriculture (Pueyo et al., 2020). Ghanaian women are often the primary providers of energy and water in our homes (Pueyo et al., 2020). Consequently, they tend to have a much more distinctive, direct knowledge in sustainable climate solutions (Lawson et al., 2020).

2.4 Local Farmers' Perception on Climate Change

In Africa, there is a high sensitivity to climate change due to a frequency of factors that increases the degree of climate related stress (UNFCCC, 2020). These factors, including budgetary constraints, lead to the inability of the established systems to adapt to climate change. This will lead to a limited adaptive capacity. Hence, Africans are more likely to perceive climate change as a greater threat than residents of developed countries who may already have established systems.

However, perception of climate change is a multidimensional occurrence (Alam et al., 2017). This is a result of the various factors that could influence perception. According to Hasan and Kumar (2020), farmers' perception of climate variation influence how they adapt to climate change. Hence, farmers' willingness to adapt to climate change depends on their knowledge about climate variability as well as its associated risks (Abid et al., 2018). An understanding of climate change

perception will aid in the understanding of local farmers concerns thereby providing adaptation strategies that are contextually appropriate (Amani et al., 2022).

Local farmers' personal understanding of climate change is hard to measure because it is hard to establish a direct relationship between a particular climatic event and climate change. Despite this, it has been recorded in works such as Eitzinger et al. (2018) that local farmers' knowledge of climate change-related events increases climate change risk perceptions. For example, in Steynor et al. (2021) work, it was discovered that if farmers perceive extreme weather events as being caused by climate change, then they are more likely to put in place measures to avert it. This is because individual experiences of extreme climate event like flooding are likely to elucidate a strong reaction that is associated with the negative impacts of climate change. This results in a higher perception of climate change risk (Weber, 2016).

Earlier studies such as Akerlof et al. (2013) corroborate the fact that personal experiences from not only climatic events, but from climatic processes such as drought or irregular rainfall patterns, which could lead to poor crop yields and other related socio-economic impacts has a significant effect on climate change perception risks. Nonetheless, other interrelated factors like cultural values and norms could have an influence on farmers' perception on climate change.

For example, a culturally-perceived interpretation of climate change such as it being an act of God as well as what might be considered as major causes of climate change has an influence on perception as well as on the adoption of adaptation strategies (Xie et al., 2019). There are other factors such as gender, age, educational level, which similarly influence the perception of climate change (Poortinga et al., 2019). Shi et al. (2015), who have focused on climate change perceptions, suggest that perceptions tend to be higher among women than men, and are often found to be

slightly higher among younger people than older people. However, what accounts for these disparities is still contested in current literature. On the other hand, research such as, Nakayama et al. (2019) posit that farmers with a higher educational level or/and a higher socio-economic status are more likely to have a higher perception of climate change due to the knowledge they have acquired. This is in line with the findings of Roco et al. (2016) on climate change perception in Chile. His findings showed that farmers with higher educational levels were more conscious of climate change as compared to those with lower educational level. This is however contrary to studies conducted by like Kehler and Birchall (2023), which highlight the point that those in a higher socio-economic level or educational such as government officials have a decreased risks of perception. This may be because of such people's disassociation from the effects of climate changes as compared to local farmers who are more likely to have less power as compared to government officials (Trope & Liberman, 2011). The above socio-demographic variances in climate change perception are important when assessing climate change adaptation and how these impact the implementation and adoption of adaptation strategies and decisions.

2.5 Adaptation to Climate Change

Humans have overtime, adopted some adaptive strategies in order to fend off the effects of climate change (Akinagbe & Irohibe, 2014). However, this is heavily reliant on their individual capacity as well as government support (Bawakyillenuo et al., 2016). Smallholder farmers in many parts of the world including northern Ghana have adopted varied strategies to deal with changes in climate (Mabe et al., 2014). According to Yomo et al. (2020), the success of these adaptive strategies is dependent on how well the vulnerabilities of local farmers are reduced as well as how strong their resilience is built.

According to Arias et al. (2021), adaptation is considered as one adapting to changes in the environment that interferes with the daily affairs or the livelihoods of humans. It includes adjustments to already existing structures in either social or economic systems. Adopting an adaptive strategy is not a linear objective as argued in (Apuri et al., 2018). It includes the decision-making process, structures as well as the human agency; like the actions and inactions taken to accommodate already the already existing changes, before a core need is identified (Fagariba et al., 2018). These processes include gathering of information on potential adaptive strategies (Lama et al., 2021). The ability of households to adopt any of these strategies is dependent on what is termed as the adaptive capacity (Siders, 2019). According to the IPCC (2014, WGII, Glossary) adaptive capacity is “the ability of systems, *institutions*, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.” In line of this, there are many different definitions of adaptive capacity. Adaptive capacity is often used to refer to a multitude of attributes and processes through which individuals or institutions are able to cope with external stressors (Angeler et al., 2019). However, there is currently no generally accepted ground on what constitutes these processes and attributes (Adger & Vincent, 2005).

The adaptive capacity of a system is a determined by compilation of various indicators and determinants (Berman et al., 2012). That is how local farmers have access to resources (Cinner et al., 2018), in order to cope with identified external stressors (Nicotra et al., 2015). Contrariwise, access to resources is dependent on social, economic and political factors (Mortreux & Barnett, 2017; Thurman et al., 2020). These factors determine “how a social-ecological system is organized in relation to its resource base, its social networks within and beyond its system boundaries and the larger historical and structural context” (Jakku & Lynam, 2010, p. 8). Nonetheless, adaptive

capacity is considered dynamic and context specific (Brown & Westaway 2011; Carter et al., 2015).

Consequently, Khanal et al. (2018) posit that adaptive capacity is context specific because of the different variations, which span across communities and countries. Therefore, adaptive capacity is determined by factors that are only specific to particular time and place (Jakku & Lynam, 2010). This imply that “the determinants of adaptive capacity are specific to the system undertaking the adaptation and its characteristics” (Adger & Vincent, 2005, p. 404). It is considered dynamic since the factors that influence adaptive capacity change over time and across space (Siders, 2019). Thus, the geographic differentials of external stressors highlight the context specific and dynamic nature of adaptive capacity (Johnson et al., 2020).

The context specific variables that regulate the adaptive capacity include access to information on the availability of potential adaptive strategies, infrastructure as well as one’s ability to innovate (Kumasi et al., 2017). This suggests that households in localities with a much higher access to resources are armed with the capacity to adopt adaptive strategies and would do better (Chemura et al., 2020). For instance, findings of Teye and Owusu (2015) on households’ adaptation in the coastal Savannah show that a community’s adoption of a strategy was dependent on the access to resources provided by the government.

2.5.1 Types of Adaptation Strategies: Planned and Autonomous

There are two types of adaptation strategies, which are autonomous and planned adaptation strategies (Bawakyillenuo et al., 2016). The former is often reliant on individual personal or household’s adaptive capacity (Rahman & Hickey, 2019), whereas the latter is dependent on the adaptive capacity of the government (Schipper, 2020). To delve in further, planned adaptation

refers to a deliberate policy decision on the part of a public agency, based on an awareness that conditions are about to change or have changed and that action is required to minimise losses or benefit from opportunities” it is either anticipatory or reactive (Awuni et al., 2023). In Ghana for instance, the National Climate Change Policy constructs the overall framework for adaptation strategies in Ghana (Dazé & Echeverría, 2016). There are five key areas under the policy. They include infrastructural development, disaster preparedness and response, agriculture and food security, and equitable social development. These key areas have been divided into ten programme areas. This includes measures to rehabilitate and expand already existing irrigation facilities, introduction of non-traditional crop varieties with short gestation weeks. Autonomous adaptation strategy includes intensification of irrigation, integration of livestock rearing into crops production, changes in tillage practices, application of fertilizers into farming practices, shift from farm jobs to non-farm jobs as well as seasonal emigration (Sterett, 2018).

2.5.2 Forms of Adaptation Strategies

There are multiple forms of adaptation, which reflect the particular change in the climate and the effects of these changes (Rodima et al., 2012). They often require innovations, institutional, technical and relational support (Biesbroek et al., 2010). This frequently involves various tailored to specific climate impacts which necessitates new approaches or improvements in areas like, changes in policies, regulations, or organizational structures, advances in technology or methods as well as improvements in relationships or collaborations among people or organizations.

Often, farmers affected by climate change realize the need to change and often adopt multi layered strategies created through their own innovation and funded without the help of a government body (Tambo, 2016). This is to mitigate or contain the decline in their livelihood due to the impact of

climate on agriculture, which is usually their source of source of revenue (Antwi-Agyei et al., 2015).

However, decision to adopt either one of these diverse strategies are often influenced by a host of external factors such as one's knowledge or access to information, availability of infrastructure as well one's financial resources (Ndamani & Watanabe, 2016). In addition, in certain instances, the government or traditional institutions have arrangements that could impede or encourage the adoption of these adaptation strategies (Dazé & Echeverría, 2016). This arrangement may or may not include institutional influence to land access, and certain actions that may pertain to some adaptation strategies (Addaney et al., 2021).

The following sections further discuss the various types of adaptation strategies adopted by various farmers.

2.5.2.1 Irrigation

Irrigation is often one of the most common forms of adaptation strategies (Bawakyillenuo et al., 2016). This because the immediate response to high temperatures as well as irregular rainfall patterns result in the creation of a stable source of water supply (Bisbis et al., 2018). Although irrigation practices may have been in practice prior to the manifestation of erratic weather conditions, there has been overtime what is known in scholarly circles as “intensification of irrigation” (Laube et al., 2012). Autonomous adaptation may manifest in various forms such as dug out or small dug out canals (Conway et al., 2019; Guodaar et al., 2021). Diesel pumps are sometimes used on streams. In planned adaptation, government or stakeholders often build dams in order to provide a steady water supply (Afzal & Chaudhry, 2023). These dams often save rainwater or channel streams to provide water (Jamal et al., 2023). Thus, in autonomous adaptation,

one's ability to adapt to irrigation is dependent on availability of irrigation facilities such as water and financial assets to rent land or to buy irrigation equipment (Antwi-Agyei & Nyantakyi-Frimpong, 2021).

2.5.2.2 Integration of Livestock Rearing into Crops Production

This is a popular autonomous adaptation strategy. Due to poor agriculture productivity, crops farmers adapt to this strategy to supplement the loss of income (Mohammed et al., 2021). This is because crop and livestock production often complement each other in the sense that, income from sold crops are used to purchase livestock, which often serves as a social asset during times of distress triggered by erratic weather pattern (Van Der Geest, 2004). Livestock also provide free fertilizer in the form of manure, which is used to provide nutrients for the soil (Bawakyillenuo et al., 2016). One's ability to adapt this strategy is dependent on the ability to rear livestock as well as availability and access to financial assets (Mohammed et al., 2021). The ability to rear livestock reflects on the space one might have as one's investment of time and resources into rearing (Antwi-Agyei & Nyantakyi-Frimpong, 2021).

2.5.2.3 Changes in Tillage Practices

This practice involves changing the planting time of some crops such as maize (Akinyi et al., 2021; Khanal et al., 2018; Sertse et al., 2021). That is, planting it at a latter or earlier time than it is known (Fadairo et al., 2020). It also involves mechanization of some farming practices such as ploughing by the use of tractors rather than human labour, intensive mixed cropping and the use of non-traditional crop variety (Appiah & Guodaar, 2022). In some places like Ghana, this practice was mainly a planned adaptation strategy introduced by the government of Ghana to deal with some of the effects that climate change has on agriculture production (Addaney et al., 2021).

Some of these effects include rain uncertainties (Williams et al., 2020). Most farmers can no longer predict when it would rain (Derkyi et al., 2018). Consequently, mixed cropping has been adapted. In this case, plants with different gestation periods are planted together (Laube et al., 2012). Thus in the event of unexpected long periods of droughts, the late maturing ones had a much better chance of surviving than the early maturing ones (Assan et al., 2018). One of the other ways to deal with rain uncertainties was farmers planting a different variety of maize with a shorter gestation period of three months rather than planting those with four months (Adu-Boahen et al., 2019). This enabled farmers to harvest some crops before the rains reduced or stopped.

What often influenced farmers' decision to adopt this practice was their financial capacity such as the irregular rains meant an adjustment to the planting calendar (Abdul-Rahaman & Owusu-Sekyere, 2017). This was, however, often available to those who could not or did not have the necessary means to purchase new seeds or new variety of seedlings (Aikins & Afuakwa, 2010).

2.5.2.4 Application of Fertilizer and Other Farming Inputs

Due to a decline in the fertility of the soil due to climate change, over cultivation as well as human actions, most adopt the use of fertilizers (Amfo & Ali, 2020). According to Agyin-Birikorang et al. (2022), most small-scale farmers particularly those who have integrated livestock rearing to crop farming have access to manure that can be used for fertilizers. However, under intensive farming such sources of fertilizers have proven to be inadequate (Wu et al., 2022). Thus, adoption of the use of fertilizer is needed. This is one of the most common forms of autonomous adaptation among farmers.

However, due to financial constraints, most farmers are unable to purchase fertilizers particularly in developing countries (Daramy et al., 2016). In the case of Ghana, government introduced a

subsidization of fertilizers (Ali et al., 2018). Although this was not in any way done as a response to climate change, the initiative has impacted on the current changes. Nonetheless, some farmers are unable to have access to fertilizers due to poor institutional arrangements, poor communication channels like corrupt officials and bureaucratic channels as well the inability to afford fertilizer despite subsidies.

2.5.2.5 Shift from Agriculture to Non-Farm Jobs

Most farmers in sub-Saharan Africa practice rain-fed agriculture and this informs the sole source of their income tied to farming (Dary & Kuunibe, 2012). The changes in weather has had serious impact on crop production and consequently impacting negatively on their sources of income (Danso-Abbeam et al., 2020). As such, one of the main adaptive strategies of the farmers was moving from farming to non-farm jobs such as trading, shea butter processing as well as carpentry (Senadza, 2014). This is often known as the diversification of livelihoods. Often, the capacity to adapt to this strategy is dependent on the already existing skills, knowledge, education, availability of training programmes to introduce new skills to the farmers (Asante et al., 2017). According to Rodima et al. (2012), the existence of social networks is a core component in enabling farmers to shift to non-farm jobs. This is because of the ability of such networks to mobilize resources to engage in non-farm jobs such as farming.

2.5.2.6 Drought Insurance for Some Crops

One of the major disadvantages of rain fed agriculture is the risk of drought (Tadesse et al., 2015). This reflects about 83% of agriculture risk in sub-Saharan Africa and causes about 40% of economic damages (Auffhammer, 2018). Small-scale farmers as well as subsistence farmers are the main victims because of market imperfections, subsistence consumption constraints as well as

poverty traps, which make them ill-equipped to contain these extreme weather stressors (Kom et al., 2023). This undermines their livelihood. Consequently, series of drought adaptation strategies have emerged aimed at coping with drought-associated risk in agriculture (Tadesse et al., 2015) crop insurance policies.

This is undertaken mostly in developed countries such as India. In some instances, insurers collect farmland and crop data and crop loss is calculated; hence a payout is given to individuals affected. In Ghana for instance, under the Ministry of Agriculture, the Ghana Agriculture Insurance Pool (GAIP) is set up as organization that uses satellite imagery to calculate crop loss and thus, offer a pay out to affected farmers. The most common crop insured is maize. The aim is to create a much more stabilised source or livelihood for farmers and attract the youth into farming.

Nonetheless, most farmers are reluctant to patronize the insurance (Bawakyillenuo et al., 2016). This is due to the lack of trust they have in the institutions, especially in how the insurance pay out was calculated (www. Reuters.com). other farmers also argue that, it was too expensive to patronize whilst others admit that they do not have adequate insight on how the programme worked. This showed how inadequate communication flow prevented the adoption of an adaptation strategy.

2.5.2.7 Seasonal Migration

Effects of climate change often influence seasonal migration (Claudet et al., 2020). Unstable rainfall patterns and an increase in temperature have an impact on crop production (Namara et al., 2018). Consequently, this encourages some farmers to migrate due to economic constraints that emerge as a result poor crop harvest. Laube et al. (2012) postulate that seasonal as well as

permanent migrations are important adaptation strategies that create additional sources of income or investment from the jobs these migrants take.

What enables this strategy is communication channel, which gives potential migrants access to information as well as interpersonal contacts at destination. Additionally, a strong financial backing gives potential migrants the chance to migrate. There are however, some social groups affected by the effects of climate change yet they are unable to migrate because of traditional norms, and unwillingness to migrate although climate change has affected them. I will discuss more of this in the latter sections.

2.6 Gender and Climate Related Migration

Migration is, and has historically been an aspect of life, and it entails different types of movements (Awumbila, 2015). This has led to a lack of consensus on what the process is. However, published reports such as the IOM Glossary on Migration (2019, p. 137) define the process as “the movement of persons away from their place of usual residence, either across an international border or within a State.”

There are often reasons, which will compel people to move from their place of origin to a destination (Carling & Talleraas, 2016). This could be to search for better jobs, gain better educational opportunities, or to escape political or religious persecution (Abel et al., 2019). The disparities between places of migrant’s origin and migrants destination result in types of migration such as seasonal migration, temporary migration as well as circular migration (Cattaneo et al., 2020).

Over the years, migration scholars such Lee (1966), and many others have developed theories that will explain the phenomenon as well as what will account for the spatial disparities existing

between the origin and destination (Bircan et al., 2020). The most common theory of migration is the push-pull theory. This was postulated by Lee (1966). The theory suggests that migration is driven by pull-push factors operating in the areas of destination and origin. The pull factors are favorable conditions, which attract migrants to the destination, while the push factors are the unfavorable conditions that drive people away from the origin (Lee, 1966). Apart from the push-pull factors, migration decisions are also influenced by intervening obstacles, such as cost of migration, immigration laws and psychological stress of leaving relatives behind. De Haas (2011) has argued that the theory was too deterministic and did not adequately explain how these factors affected the different social groups in the society such as the old and young, men and women.

According to several scholars including Awumbila (2015), Lohnert (2017), Sirkeci & Cohen (2015) most of these theories are inadequate in explaining the diverse drivers of migration. This is obvious with the topical issue of migration and climate change. Although in some instance climate change served as a driver of migration, it often did not work in isolation as argued by (Black et al., 2011). For instance, people sometimes take the decision to migrate in response to a combination of factors which could include environmental factors (Awumbila et al., 2014) and socio-cultural factors such as joining a spouse (Anarfi & Kpakpa, 2013).

As previously established, women in rural households are more likely to be at the brunt end of the effects of climate change (Akinsemolu & Olukoya, 2020). This is as a result of some customary values such as land inheritance issues and cultural gender norms as well as inadequate resources women are less likely to adopt effective adaptation strategies as compared to men (Assan et al., 2018). In addition, in most rural communities, women were less likely to adopt migration as an adaptation strategy (Sarpong, 2021). This is because of some social structures such as patriarchal beliefs; that encourage the narrative that men are the sole partakers of migration. (Daley & Pallas,

2014). For instance, in places like Northern Ghana, men often migrated down to the south to work as tenant farmers or farm labourers during the North's off farm season (Arthur-Holmes & Busia, 2022). The women stayed behind to look after the house (Bonye & Kpieta, 2012). Women who decided to migrate were looked upon with disdain and it was believed that they brought shame unto their households (Porter, 2011). However, in recent years there has been an increase in female migration from the Northern Savannah zone of the country (Awumbila, 2015; Azumah & Ahmed, 2023; Dery, 2016).

Nonetheless, the adverse effects of climate change in recent years such as desertification has led to a depletion of farmlands and has resulted in low agricultural productivity (Awumbila, 2015) and overwhelming economic repercussions. In addition, the extreme depletion of farmlands has reduced women's accessibility to farmlands to cultivate some crops to sell and to eat (Azumah et al., 2022; Lawson et al., 2020). In such instances as required by traditional established norms, their husbands often took the initiative to migrate down to the south (Guzmán et al., 2008). However, the refusal of husbands to return home or marrying other women after migrating has encouraged more women to migrate (Pickbourn, 2016). The above raised issues coupled with an increase in women's education and the implementation of women empowerment programmes have encouraged the feminization of migration (Azechum, 2017).

According to Alatinga (2019), the economic cost of adhering to long held norms about women's role in migration has proven to be far costly because of insufficient funds to manage the home. This has encouraged women to challenge longstanding beliefs about their role in migration (Lattof et al., 2018; Rufai et al., 2020). For example, a study carried out by (Anarfi & Agyei, 2009) shows that 70% of women independently decided to migrate 57% of them personally funded their journey. Nagla (2008) and Awumbila (2015) argue that an increase in female migrants has led to

the restructuring of traditional family dynamics. For example, an increase in migrant mothers has led to a diminished involvement in active motherhood since other family members or friends often have to step in to provide childcare responsibilities or take up motherly roles in the mother's absence (Contreras & Griffith, 2012; Fan et al. (2018). In this regard, mothers migrating independently without their children are dependent upon family members' ability to fulfill the daily caregiving role (Caarls et al., 2018). On the other hand, it is argued that, migration has a positive impact on motherhood (Bottomley, 2020). This is because migrant mothers are in a better position to provide needed resources for the child's development as well as provide required material resources such as good housing for their children (Erel, 2020).

In regard to migrants' destination choices, there are factors that influence one's choices (Egger et al., 2021). These include, but not limited to the availability of jobs, education, and escape from traditional norms as well as effects of climate change (Smith, 2015). There are certain instances whereby one's gender influences a destination choice (Apinga et al., 2022; Baada et al., 2019; Tufuor et al., 2016). For instance, in Ghana, to avoid capture and forceful return to rural areas, most migrant women from Northern Ghana decide to move to Accra, one of the major urban centres and where most may already have established social networks (Awumbila et al., 2017). In addition, regarding the choice of destination, gender may influence where migrants work (Bastia & Piper, 2019). In Accra, for example public spaces are historically gender demarcated (Baada et al., 2019). Places such as markets are associated with female entrepreneurship, whereas bus stations are associated with male entrepreneurship (Stasik, 2016).

2.7 Migration as a Climate Adaptation Strategy

Human mobility has long been used as strategy to cope against the unpleasant changes in the environment (Teye et al., 2015). This is seen in the lifestyles of pastoralist and nomads (Piguet et al., 2011). In recent years, however, the distinct relationship between human mobility and climate change has drawn the attention of scholars. This is partly because of reports from organizations like the IOM (2018). This phenomenon has led to the emergence of terms such as environment migrants to represent those who have been displaced by changes in the climate. Although there has been quite a substantial amount of study carried out to examine the link between climate change and migration (Black et al., 2011). There however, seems to be an unaccepted stipulated number on what exactly could be the projected number of environmental migrants soon (Toscano, 2015).

The IPCC (2021) has estimated the number of environmental migrants to reach 250 million by 2050. However, this number has been disapproved because of the dissatisfaction on what constitutes environmental migrants (Mayer, 2016). The disagreement is belied with the constant belief that migration is a multi-causal phenomenon. This is because of what is considered as the drivers of migration which includes factors such as political, social, economic, and cultural (Carling & Collins, 2018). Reviewed literature such as Awumbila (2015), Saghir, and Santoro (2018) have brought to the forefront how the socio dynamics as well as established structures in society could be impacted differently because of the changes in the environment. This then dictates whether individuals or household adaptive capacity will enable them to adopt other adaptation strategies other than migration. This is not to suggest that migration as a last resort means that one has weak adaptive capacity (Bawakyillenuo et al., 2016). But rather, it shows the flexibility on

one's capacities. Nonetheless, it should equally be noted that often the vulnerability of one's adaptive capacity might dictate their decision to migrate as their only alternative.

Even so, regardless of the contestation in the multiplicity of migration dimensions (Awumbila 2015), what serves as a common ground is that households, which heavily depend on rain fed agriculture are often severely affected by climate change and often people are propelled to opt for migration as an adaptation strategy (Castaldo et al., 2012). This creates the need to examine and refocus on the relationship between climate change and migration, by understanding the other drivers of migration to comprehend its impact on trends and migration patterns in Africa.

In the case of Ghana, migration is one of the commonly accepted important livelihood strategy (Awumbila et al., 2019). Current internal migration trends of the country show that the act has deeply been rooted in historical antecedents (Awumbila et al., 2017; Casentini, 2018). In eras like the 19th century, migration trends in Ghana were primarily influenced by “favourable” ecological needs such as fertile land for agriculture, a good site for trade as well as a good site that serves as a security for tribe (de Haas, 2010). This is evident in the current location of most ethnic tribes in Ghana (Cogneau & Moradi, 2014). However, before the institutionalization of border into the geography of Africa, most of these movements were not considered as cross border migration (Adepoju, 2005; Fayomi & Adeola, 2015).

However, overtime, due to the restructuring of political systems, colonialism and independence the trajectory as well as trends of migration has changed (de Haas, 2010). For instance, in the colonial era, labour migrants moved from the northern savannah zone to the mining and plantation areas in southern Ghana (Nshimbi & Moyo, 2017). This was because of the use of the Northern territories as labour reserves for the South by the British in early twentieth century (Fioramonti &

Nshimbi, 2016; Usro & Hakami, 2020). This served as the supply of cheap labour for the mines and general labour in the cities in southern Ghana (Abdul-Korah, 2011; Ceesay, 2017). This era had its migrants being predominantly unmarried young men and virtually no women in migration (Adaawen, 2017). This was because most of the labour migrants had to work in mines and on farmlands, a job that required a great deal of physical strength and was deemed unsuitable for women (Cordell et al., 2020)

Nonetheless, after independence, the migration trends and patterns of the country have still been influenced by the colonial era although in a subtle way. For instance, development and economic disparities between the north and the south have continued to serve as a driver of migration from the North to the South of Ghana (Bauer et al., 2020).

Most of these migrants move to either the cities (see Arthur-Holmes & Busia, 2022) or to the forest zones to work as farmers (Van Bommel, 2020). What usually served as the push of these migrants from their place of origin is often poor agricultural productivity due to poor farming practices, over grazing and overuse of fertilizers (Sward, 2017). Another pertinent cause is climate change (Fagariba et al., 2018; Tilahun et al., 2017). This has caused series of drought leading to desertification and poor agricultural productivity (Owusu, 2018). The depletion of farmland and poor agricultural productivity has prompted the young men and women of the Northern zone to migrate to the southern zone (Naab et al., 2019).

Reviewed literature such as Awumbila (2015) and Abdul-Korah (2008), have shown that historically migration trends were occupied by young men most times unmarried. This was however, due to the established patriarchal institutions). Recent scholarship, such as (Awumbila

et al., 2014), has shown that in recent years migration is increasingly being feminized in Ghana though men continue to saturate the trends.

2.7.1 A Historical Perspective on Migration in Ghana

Ghana has had a long history of migration in the sub-region (Mensah et al., 2022). The country serves as a place of origin, transit as well as a destination for migrants (Gravesen et al., 2020). Prior to the colonial era, migration was a part of the livelihoods of Ghanaians (Arthur-Holmes & Busia, 2022). This is evident in most established migration patterns, which are often fixed and dependent on family and social relations, as well as mutual support among family and friends (Issifu et al., 2022).

Nonetheless, there are factors that influence the dynamics and trajectory of Ghana's migration history. For example, mobility policies in the colonial era focused on labour recruitment from the Northern part of Ghana to work on Southern Ghana plantations and mines (Charway & Houlihan, 2020). This reflects in modern day North-South migration patterns in Ghana (Beauchemin et al, 2020; Kumar, 2022). Moreover, other factors like the 1970s economic crises and the 1980s droughts influenced the migration patterns of Ghanaians (Schans et al., 2018). This is because these two events led to a diminish harvest of crop yields in peasant agriculture as well as an overall decline in state farms productivity and a decay in per capita income (Gravesen et al., 2020). These political and economic factors served as a major push for international migration among Ghanaians (Amoah et al., 2021). Some of the destinations are as included areas in the sub region that is Nigeria, Ivory Coast as well as Benin (Marks & Stys, 2019). Nonetheless, certain restrictions such as the mass deportation of Ghanaians out of Nigeria in 1983, and in 1985 encouraged some to seek better livelihoods and security outside the continent or the sub-region (Daly, 2023). It is note-

worthy to mention that the 1979 ECOWAS free movement protocol granting free movement of persons and establishment within the West African Sub Region was already in effect (Arhin-Sam et al., 2022). Hence, movement of Ghanaian migrants to these African countries were legal (Aniche, 2022). This highlights the complicated, yet regulated migration with the sub-region that has continued even to today.

Other political factors such as corruption and harsh military regime in the 1980s equally influenced the decision of Ghanaians to seek asylum in countries like Germany, Libya and the UK (Gravesen et al., 2020). This continued even into the fourth republic of Ghana, which ushered in a new dispensation in the political arena, that is, political stability through the introduction of parliamentary democracy (Akoeda et al., 2023).

2.7.2 Migration patterns in the Upper West and Eastern Regions

Migration in the Upper West Region is characterized by permanent, circular, and dry seasonal migration, both internally and externally (Antabe et al., 2019). A review of current data trends suggest that, since the 2000s, the Upper West Region has continually experienced negative net migration, with most migrants heading to the southern part of the country. (Atuoye et al., 2019). Scholars such as Fuseini et al. (2019) argue that a key reason for this pattern is that the Upper West is ranked as the poorest region in Ghana, which is attributable to its limited facilities.

For instance, the region has higher illiteracy rate and fewer accesses to amenities like higher education, good road networks as well as amenities such as a good health care (Jaha & Sika-Bright, 2015). In addition, the region like other parts of the country relies heavily on rain-fed agriculture. Its harsh climatic conditions and mono-annual rainfall season creates unstable income for farmers. In contrast, regions located in the southern part of the country, have relatively higher social and

economic opportunities. Hence, most migrants in the Upper West Region move to rural and peri-urban areas in southern areas like in the forest and transitional agro-ecological zones often in search of on-farm jobs like farm labourers and off-farm jobs like miners.

Regarding gender distribution in migration, most migrants from the Upper West Region are men. As stated earlier, this is as a result of earlier colonial policies which enforced male labour recruitment from northern Ghana to plantations and mines in southern Ghana (Baddianaah et al., 2023). Another reason, for the high male ration in migration is the nature of the jobs at destinations (Bieteru, 2019). Mostly, men are involved in aspects of agriculture work as farm labourers, some in illegal logging activities and mining (Braumah et al., 2022). Most women are discouraged from engaging in such jobs since those jobs are considered masculine in nature.

Even so, some women utilize their agency and engage in harvesting activities and in some instances; they find jobs in housekeeping (Shattuck et al., 2019). There are few women who also engage in illegal mining. In Awumbila (2015), it is shown that some female migrants engage in sex work, although they do not do this openly, due to societal norms. During the day, some of these female migrants are food vendors for labourers and miners and at night, they are sex workers. Other research works such as Yendaw et al. (2016) show that some female migrants purposely travel down south in order to engage in sex work. They, however, employ themselves in other forms of livelihoods until it is time to partake in the sex work (Herrick, 2020).

Despite historical policies and jobs determining the destination of migrants, there are times in which tribal differences determine the destination of each gender (Amuakwa-Mensah et al., 2019). For instance, in recent years, Daagaba female migrants move further south to Accra the capital of the country in order to brew and sell items in order to derive financial independence (Baada et al.,

2019). Other tribes such as the Waala females often migrate into Southern cities to look for domestic work and at times engage in sexual work, whereas Waala male migrants migrated to the big cities in South to trade (Lawson et al., 2020). This was often a trademark of Waala migrants (Gravesen et al., 2020).

Migration patterns in the Eastern Region

Eastern Region has continually recorded a negative net migration since the early 2000s. This is surprising because regions who report negative out migration like the Upper West Region are considered the least developed and have poor agricultural productivity. Gravesen et al. (2020) suggest that a reason for Eastern Region recording negative net migration might be because of its close proximity to Greater Accra Region, which is a common destination point for most migrants. Further data from the 2021 GCM survey shows that social transformation has increasingly led to an access to education and improved information; hence, the youth were encouraged to migrate. Nonetheless, the region serves as a destination point for most migrants from the North.

2.8 Climate Immobility

Human mobility has been in existence for years (Meekan et al., 2017). According to De Haas (2021), human mobility refers to the voluntary or involuntary movement of people, including interventions from government that aid in the resettlement of people. IOM (2018, p. 93), describes human mobility as “a generic term covering all the different forms of movements of persons”. It has often been seen as a mode for one to seek better employment opportunities, escape unpleasant circumstances or as a mode to spread risk regarding climate change effects (Cundill et al, 2021). In recent years, human mobility is often deemed as the most common response to climate change

(De Haas, 2021). This is due to the adverse effects climate change continually has on the livelihood of people (Azumah & Ahmed, 2023).

Often, the decisions to migrate are due to low agricultural productivity as well as other “environmental push” factors (Abu et al., 2014; Bettini, 2017). Yet, climate is just one of the many factors why people decide to migrate (Foresight, 2011). In a recent study by Maharjan et al. (2020), it was realized that in climate hotspots such as India and Bangladesh, climate stress was not the primary reason for migration, but rather economic factors, such as employment opportunities. However, temporary displacement could emerge as result of extreme climate events such as flooding, earthquakes or cyclones. However, Black et al. (2011) suggests that livelihood insecurity emerges as result of the climate threat on agricultural productivity. Nevertheless, this does not serve as primary mobility driver, but acts as a “threat multiplier of pre-existing vulnerabilities” (Cundill 2021: 2). This has drawn the attention of the international communities, scholars and scientists alike (e.g Martin et al., 2021), and has further shone the spotlight on climate mobility, its management, adaptation, and mitigation as well as its political connotations (Siddiqui et al., 2019).

Despite this, there is often an overlooked phenomenon that is people who are affected by the impact of climate change, and yet they do not move. This is termed as climate immobility. According to Zickgraf (2018), the capacity to migrate in the face of climate change effects is dependent on the wealth as well as connections of the household. Hence, the wealthier and more connected households are likely to migrate as compared to poorer households, as the poor households may be unable or unwilling to move. The ability to migrate is also dependent on a host of a variety of intersecting factors such as gender, age, social networks and some instances, formal education. In the case of gender, studies from Ghana (Setrana & Kleist, 2022) and South Asia

(Siddiqui et al., 2019), show that men are more likely to migrate than women in the face of climate change. Also, Singh (2019) suggests that married people as well as those with a higher formal education are more likely to be mobile in the midst of climate change context.

There are a host of reasons that explains why some people are left behind. For example, there are cultural norms which restrict female mobility, mainly because of the care-giving responsibilities of women at the household (Cundill et al., 2021). Married men find it easier to migrate because their wives can facilitate household maintenance as well as take care of the elderly and children (Parreñas, 2015). There are however, some instances those left behind are in a much more advantageous positions than migrants compelled to leave (Tripathy et al., 2022).

Accordingly Rao et al. (2017) shows that men in some parts of the Northern Ghana migrate because of less opportunities for jobs that are culturally considered masculine. However, leaving some household members behind tends to have a ripple effect on agricultural productivity (Singh, 2018). For instance, when women are left behind, they are often considered as the main source of labour for farming. Though this increases the responsibility of women in the agricultural productivity as well as promote cooperation between men and women in land management, data from various studies show that access to financial resources as well as extension services continues to be male dominated (Ye et al., 2016). Also, the burden of household responsibilities weighs heavily on how women carry out these tasks (Maharjan et al., 2012).

Additionally, some people are unable to migrate because of poor financial capacity, or inadequate social or human capital (Cundill et al., 2021). That is, people are likely to migrate if they can facilitate the movement such as acquiring the means to pay for transport, or already existing networks in destination areas as well as the resources to set up a new home in the destination areas

(Boas et al., 2022). Consequently, a strong attachment or as well as good social networks at place of origin may encourage some to stay behind even if they have the means to travel (Farbotko & McMichael, 2019). The decision to stay behind in the midst of climate change effects despite having access to resources that can facilitate migration is known as voluntary immobility, whereas, the decision to stay behind as a result of inaccessible resources or other related factors is known as involuntary immobility (Tripathy et al., 2022)

2.8.1 Voluntary and Involuntary Immobility

According to Carling (2002), voluntary immobility refers to people who prefer non-migration to migration or people who believe that the benefits of non-migration outweigh that of migration. Often, people in the youthful population choose to stay put, which is in contradiction to earlier studies which suggest that the youth have a lot more to gain from migration in terms of employment or education. In most cases, the youth and some instances women are considered to aspire for higher levels of schooling, attain financial independence, this is particularly associated with those in resource poor household in rural communities (Adams, 2016; Farbotko & McMichael, 2019). Until recently, it was believed that the youth were more likely to migrate, since as one grows up and expands, the family migration expenses increase. However, Carling and Schewel (2020) indicate that some social groups such as the youth and women choose to stay because of family-related reasons. For instance, in Schewel and Fransen's (2022) study on work among the youth in Vietnam, India and Ethiopia, it was indicated that some important reasons for staying behind included being happy in their current location, having a good job and an overall wellbeing. Some also stay behind because of land or other forms of properties. Some voluntary non-migrants believed that migrants were not as successful as those at home.

2.9 Theoretical Perspectives on Relationship between Environmental Change and Migration

The regular contestation belying the relationship between environmental change and migration has led to the emergence of two schools of thoughts on the topic (Van der Land et al, 2018; Yavçan, 2018). These schools of thoughts are known as the minimalists and maximalists (Adger et al., 2015). Each school reflects on the stance of scholars on the impact of environmental change on migration (Borderon et al., 2019). Some scholars are of the opinion that changes in the environment have a direct impact on migration whereas others are of the opinion that changes in the environment are not an isolated factor (Adger et al., 2015), but rather works with other societal factors such as economic, social, and political to influence migration (Adams,2016). However, determining the direct impact environmental changes have on migration is determined on spatial-temporal occurrence (Gemenne & Blocher, 2017). Hence, there are two types known as climate processes and climate events.

Climate processes refer to the slow onset changes to the environment such as drought, desertification, and deforestation (Abel & Cohen, 2019). These processes may affect or cause migration albeit not directly or immediately (Beine & Parsons, 2015). On the other hand, climate events are the sudden ones such as earthquakes, tornadoes, hurricanes etc. though climate events often receive the most coverage and attention (Backhaus et al., 2015). Azumah and Ahmed (2023) are of the view that climate processes have a larger implication on migration patterns and movements. This is because the gradual nature of the climate process encourages individuals to have time to either adapt to the situation such as set up an irrigation system, utilizing more fertilizer, or shift to a non-farm job (Castelli, 2018). Equally, slow onset creates the opportunity for the government of a particular demography to adopt adaptive strategies (Yavçan, 2018).

Therefore, individuals' decisions to migrate may be borne out of inadequate adaptive capacity (Gemenne & Blocher, 2017), due to restrictive factors such as age, social and marital status as well as gender (Awumbila et al., 2014). This suggests that a proper management of slow onset climate process can influence and impact migration patterns and causes (Gray, 2016).

On the other hand, climate events due to the sudden onset climate issues such as flooding, earthquake, and tornadoes might create an immediate displacement of individuals of a particular demography who may have no other alternative than to migrate (Black et al., 2011; Renaud et al., 2011; Foresight, 2011). In this scenario, individuals might choose to return after migration if there is an intervention to resolve whatever havoc the climate events might have caused (Warner et al., 2010). The decision to remain permanent migrants might be based on several factors such the migrant's integration in the new society or the government's inability to renovate on time (Foresight 2011). These factors have led to the emergence of the maximalists and minimalists' perspectives on climate change induced migration (Cole, 2020).

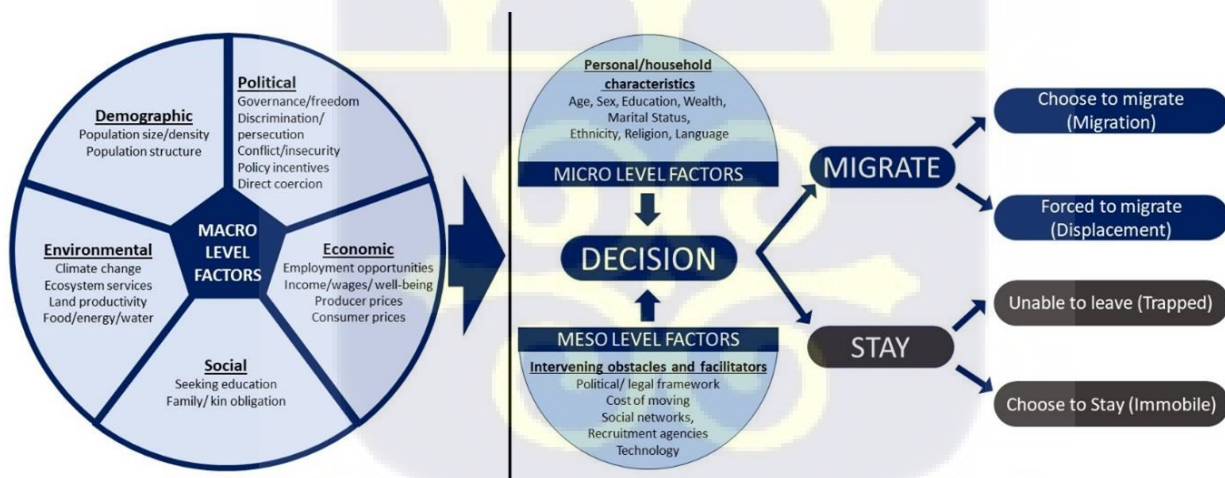
Maximalists are of the view that climate change has a direct effect on migration without considering the social, economic, and political factor that interplay with situations during a slow onset climate process (Codjoe et al., 2017; Van der Geest, 2011). Minimalists are of the contrary view that environmental change does not solely influence migration, but it is involved in the interlinkages of other factors such as economic, social, and political (Awumbila et al., 2014).

The conceptualization of the relationship between environmental change and migration is caught in conceptual framework such as the foresight, and entitlement framework.

2.9.1 Foresight Framework

The foresight framework assumes that migration is shaped by five factors including environmental change (See Figure 2.1). Consequently, environmental change does not work in isolation but will interact with these existing factors to cause migration (Foresight, 2011). Based on this theory, the most important drivers of migration are economic drivers, which entail employment opportunities, income levels, rural wages, and agricultural prices (Paliokaitè et al., 2014). Other drivers of migration mentioned by the model are: Political factors (government policy, incentives for migration etc), Social drivers (family obligations, migration for education), demographic drivers (age structure, population size etc) (Hines & Bishop, 2013). These other drivers will interact with environmental drivers (climate change, soil erosion etc) to cause migration.

Figure 2.1: The Foresight Framework=



Source: Adapted from Foresight (2011) and Teye et al. (2022)

While the five main macro-level drivers serve as ‘push factors’ of migration, the decision to migrate or stay at any place experiencing environmental change is taken by individuals-based assessment of different meso-level factors (e.g. migration policies, cost of moving, and social

networks) and micro-level factors (e.g. age, gender, education, income) (Potocky & Naseh, 2020). The interaction between macro, meso and micro-level factors implies that when faced with climate/environmental change, some of the affected people may migrate, while others may remain at the origin (Teye & Nikoi, 2022). The group that chooses to remain voluntarily at a place experiencing climate/environmental change because they do not want to leave their usual places of residence constitutes the voluntarily immobile population, and the phenomenon is termed as voluntary immobility. On the other hand, individuals and households that are facing serious environmental challenges and would have wished to migrate but are ‘forced’ to stay at the origin because they lack the resources and social capital to migrate are said to be ‘trapped’ (Foresight, 2011). This scenario situation is termed involuntary immobility.

2.9.2 Entitlement Framework

The entitlement approach was first used by Amartya Sen to explain food insecurity during plenty production (Sen, 1981). Since then, it has been used by various scholars to explain environmental change (see Leach et al., 1999; Teye, 2013). According to Adger (2003), entitlements refer to the resources within the reach of an individual or household and this is determined by either their own production, assets or reciprocal and non-reciprocal arrangements. The endowment set of an individual include both tangible assets (e.g., land, equipment) and intangible assets (e.g., skills and knowledge). Teye (2013) refined the concept of endowments to refer to the *rights and resources* that social actors have in a society. Following the work of Teye and Owusu (2015), one can assume that households and communities can effectively deal with climate change variability if they have appropriate endowments (i.e., rights and resources). The inability to adopt effective adaptation strategies could be attributed to entitlement failure emanating from government policies, and unfavourable political and economic structures (Teye & Owusu, 2015). Households and

individuals with appropriate endowments may not migrate in response to environmental change, because they can adopt in-situ strategies effectively. On the other hand, those who want to migrate will also need some endowments (rights and resources) to be able to undertake migration.

As highlighted earlier, the entitlement framework can be used to assess the various ways individuals or households access resources and convert them into well-being. In this study, it will be useful in emphasizing how social, cultural, economic, and political factors influence local farmers' access to resources and, in turn, their adaptation strategies. For example, male farmers in Yilo Krobo are more likely to adopt irrigation due to traditional inheritance norms, which often result in them inheriting farmland close to water bodies. Additionally, gender norms make male farmers more likely to work as laborers on plantations, providing them with an extra income stream to purchase irrigation equipment. By examining individuals' entitlements, the framework can also determine which social groups are more vulnerable to climate change effects and, therefore, more likely to adopt migration as an adaptation strategy. One major critique of the entitlement framework is its overemphasis on economic factors, which can overlook the complexities of other influencing factors. To address this, the structuration theory used in this study helps to highlight other structures that interact with economic factors.

Entitlement framework and gender relations

Environmental issues are significantly influenced by gender due to the historical connection between gender and nature, the gendered interaction of human labor with the environment, and its impact on environmental attitudes and actions (Doss et al., 2015; Nightingale, 2006). Gender plays a key role in determining people's access to ecosystem services, their susceptibility to climate change, and their ability to adapt (Dankelman, 2010). However, there is unequal access and control

of natural resources in rural societies, particularly with female farmers typically facing more insecure land rights and lower productivity compared to men (Meinzen-Dick et al., 2014; Tsikata 2016).

Additionally, the adaptive capacity of various social groups is often dependent on their access via their right and endowments to resources (Fisher et al., 2013). Gender relations facilitate the access to these resources through institutions or structures like traditional inheritance norms, customary laws and traditional gender norms (Rocheleau et al., 1996). The entitlement framework is useful in this study because it brings together essential components of gender theory and the environment by emphasizing on social difference and the role of cultural structures influencing different social groups' access to resources (Chanamoto et al., 2015). This further translates into the adaptive capacity of social groups. It is mainly useful because it also embraces the modification of the idea that gender may be impacted by different identities like class hence acknowledging the heterogeneity of women groups in the same community (Poole et al., 2016). Furthermore, it reflects the flexibility on how institutions such as marriage facilitates or restrains for example, women's access to resources. For instance, as reflected in this study, though married women may have restricted mobility by virtue of their marriage, they may however have access to land as result. Studies such as Umaru Baba and Van der Horst (2018) work in Northern Nigeria indicates that the women's rights and access to resources were dependent on their relationship to men in their society either through marriage or kinship as well as other forms of intrahousehold arrangement.

In this study the entitlement framework aided in examining how cultural structures like traditional gender and inheritance norms influences men and women's access to resource and how it either enables or constrains their adaptive capacity.

CHAPTER THREE

METHODOLOGY OF STUDY

3.1 Introduction

This chapter presents the study area and the methodology employed for this study. In this chapter, an illuminating context for the study is presented. The study area section will highlight the location, physical characteristics, economic activities, and the political and social organization of each of the study regions. The section on methodology starts with a presentation on the epistemological underpinning of the study. This is followed by a justification on the mixed methods design employed for the study. It is the belief of the researcher that mixed methods design will ensure that the strengths of one method compensate for the weaknesses of the other. The chapter further highlights the methods of data collection, i.e the design and execution of the quantitative data collection technique (survey) and the qualitative methods (in-depth interviews and focus group discussions). As well as, taking into consideration the researcher's positionality, ethical consideration as well as limitations of the study.

3.2 Study areas

The two regions of study are part of the 16 regions of Ghana. Traditionally, the country has been demarcated into 6 agro-ecological zones and these are the Guinea Savanna, Coastal Savanna, Sudan Savanna, Evergreen, and Deciduous Forest (Asare-Nuamah & Botchway 2019). However, due to REDD+ development strategy purposes, they have sub categorized into three major agro ecological zones (Abbam et al., 2018). They are the High Forest, Savannah and Transitional zones.

Traditionally, climate change studies in Ghana have often been focused on the Northern Savannah Zone (Antwi-Agyei et al., 2015; Lawson et al., 2020). This is because geographically, the Northern Savannah agro-ecological zone is one of the driest in country (Incoom et al., 2020). On the other hand, it is socio-economically one of the most sparsely inhabited zones (Quaye-Ballard et al., 2020). It constitutes 17.1% of the population yet utilizes 41% of the land space. The three Northern regions of Ghana, which is the Northern, Upper east and the Upper West are considered poorly developed and also have a high incidence of poverty. This is attributed to the colonial era administration as well as post-independence government paying little to no heed to the region's development (Alhassan et al., 2018; Jaha & Sika-Bright, 2015). Also, the high incidence of climate change effects, such as notable changes in temperature coupled with socio-economic problems such as high poverty rates makes the regions located in this zone one of the most affected by the effects of climate change (Abu et al., 2014).

As a result of such factors, most climate change studies in Ghana such as mitigation and adaptation strategies have often been focused in this zone (Mabe et al., 2014). The Northern Savannah Zone tends to produce a large percentage of the country's migrants (Awumbila, 2015). This often encourages an extensive and inclusive study on the socio-economic impacts of climate change on migration trends as well as the gendered differentials of such effects

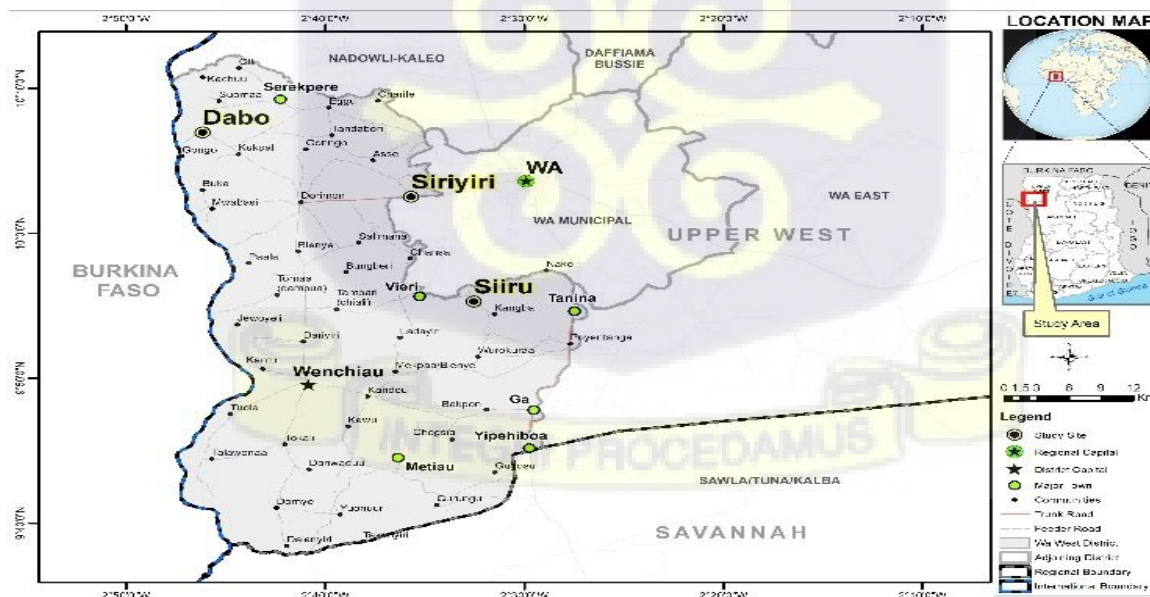
Furthermore, government intervention, as well as climate change-related policies, regularly have the Northern Savannah Zone as the focal point of their concerns and policy drive (Adu-Boateng, 2015; Etwire et al., 2022). This is despite the evidence of climate change in regions such as the Ashanti, Brong Ahafo and the Eastern. These are in the Tropical Forest Zone of Ghana and are usually neglected in climate change studies and interventions in Ghana. This neglect may be as a result of these regions' long standing history of serving as the destination of most climate-related

migrants from the Northern Savannah zone (Abu et al., 2014; Fielmua et al., 2017). On the premise that climate change occurs in the tropic forest zone and equally has socio-economic effects on the region, this study serves as a study between the two regions located in the Northern Savannah zone and the Tropical Forest Zone. That is Wa West district in the Upper West region and Yilo Krobo in the Eastern Region.

To further understand the spatial dynamics associated with the impact of climate change, the study was conducted among three communities each from the Northern-Savannah and the Tropic Forest Zone. It is the belief of the researcher that an analysis of two districts located in two different regions, the Wa-West in the Upper West region and the Yilo Krobo in the Eastern region will help establish how various structures such as gender, inheritance and traditional norms interact with various adaptation strategies and assist in making well-informed migration decisions.

3.2.1 Upper West Region

Figure 3.1 Map of Wa West District Showing Selected Communities



Source: Extracted from district shapefiles of Ghana 2022

Wa West is one of the 11 districts in the Upper West Region and its regional capital is Weichau. It is considered as one of the poorest districts in Ghana (Atuoye et al., 2019). Traditionally, agriculture has been the main economic activity in the district. Crops such as shea, okra, millet, sorghum as well as climate suitable crops are grown in the district and the Upper West region as a whole. Animals such as guinea fowl, sheep, goats, cattle as well as fishes are often reared. Nonetheless, the district is often interspersed with other economic activities such as trade, weaving, fishing, and service-provided related jobs and in recent years mining (Fuseini et al., 2019). These activities however, do not reflect in alleviation of poverty in the region (Alhassan et al., 2018; Asodina et al., 2021; Jaha & Sika-Bright, 2015).

Such poverty levels are accredited to inadequate development programmes in the region as well as the poor implementation of poverty alleviation schemes during and post-colonial era (Abdulai et al., 2018). Fagariba et al. (2018), however, argue that the above-stated reason is only a fraction of the cause. They suggest that a key factor for the district's high poverty levels is its great environmental stress. This is attributed to the district's location in the arid Northern Savannah zone, as a result, the district is heavily impacted by the effects of climate change and its interactions with existing social issues such as gender inequality in accessing resources or intermittent political conflicts. This in turn exacerbates poverty levels. Consequently, its high dependence on rain fed agriculture equally affects food security and income levels of farmers in the district. Often, strategies are adopted to deal with issues that have to do with climate change. Among these strategies is migration, which has been a long-standing practice in the district (Awumbila et al., 2014; Osumanu & Akomgbangre, 2020; Yiridomoh et al., 2021).

In view of this, the study selected three farming areas, i.e the Siiru, Dabo and Siriyiri communities from the Wa West district to ascertain how climate change interacts with gender and other factors

in the society and to further determine the impact it has on migration as well as the adoption of certain adaptation strategies.

3.2.1.1 Location and physical characteristics

The Wa West District shares boundaries with the Sawla-Tuna-Kalba District to the south, Wa Municipal to the East, Nadowli Kaleo district to the North and Ivory Coast to the East. It lies approximately between longitudes 9° 40' N and 10° 10' N, and between latitudes 2° 20' W and 2° 50' W. It covers a total land area of 1,458 square kilometers.

The Wa West District experiences two marked seasons, the wet and dry seasons. Mean annual rainfall in the area ranges between 840 mm and 1400 mm. The rainfall regime is characterized by high variability thus high unpredictability. For instance, in some years, the first rains in April and May are followed by a short dry spell of three to five weeks, resulting in serious crop damage. During the dry season (September – March), the region is influenced by the dry north-east trade wind (Harmattan) and during the rainy season (April – August), the area is under the influence of the maritime air from the southwest monsoon. In addition, the region experiences high temperatures, which are further discussed below. These climatic conditions pose challenges to agricultural production, the region's main economic activity.

Since 1970, the District has experienced an increase in the mean maximum temperatures with an average of 0.023 °C. This represents a cumulative average increase of 1.15 °C since 1970. Within 1970-2019, the average maximum temperature measured was 33.7 °C with a CV of 1.30%. This highlights the propensity of temperatures to rise in the near future. For instance, as on record (See Chapter 4) maximum temperatures have been greater than the observed average since 2001, while 2015 was seen as the hottest year with a temperature of 34.7 °C.

3.2.1.2 Economic activities

A large section of the populace indulges in agriculture production. Collectively, it has the second highest number of agriculture-based household in the country (Antwi et al., 2015). Due to its location in the agro-ecological zone, i.e the Northern Savannah, dawadawa and shea trees characterize the region and their fruits serve as a source of food in the form of cooking oil and some in instances pomade for the body (Kusakari et al., 2014). Women in the District often cultivate the trees and turn the nuts into pomade and this is sold and serves as a source of income for them. In certain instances, the trees in the zone are considered as a source fuel and material for house construction. Other trees such as the neem and mango trees are also common in the region. The rosewood for instance, is often logged and processed for exports.

However, other sections of the district's economy engage in crafts and related trades including pottery, carving, and offering of services such as banking. Nonetheless, there is a distinction between rural and urban economic activities (Forkuor & Korah, 2022). Often most households in the rural areas engage in agriculture activities, whilst the urban centres are mostly into trade, crafts, sales and services (Donkoh et al., 2018; Fuseini et al., 2019). Regardless of the obvious distinction between the rural and urban centres, the district has a high dependence on rain-fed agriculture. This further echoes the unstable and perilous nature of livelihoods in the region as a result of climate variations and why it is considered one of the poorest regions in the country (Donkoh et al., 2018). Furthermore, most of the rural population do not have enough non-farm job opportunities such as a mining, quarrying, manufacturing and construction in order to diversify.

3.2.1.3 Demographic characteristics

The Wa West District hosts approximately 96, 957 of the Upper West region's population (GSS, 2021) with a population density of 65.10 kilometer square. Between 2010 and 2021, it has had an annual percentage change of 1.6%. The district is made up of 52.7% females. This makes up about 51, 077 of the population and 47.3 % males, which constitutes about 45 880 of the population (GSS, 2021). The district is primarily made up of the youthful population with 41.2% (39 954) below 15 years and 52.5 % (50 917) made up of people between 15-64 years. A large section of the district is entirely rural as with other districts of region. As stated earlier, the district is primarily dependent on agriculture for livelihoods (Donkoh et al., 2018).

3.2.1.4 Political and social organization

The Wa West district is one of the 11 District assemblies in the Upper West Region of Ghana. It emerged as a separate district from the Wa district in 2004 under the local Government Act 463, 1993. The district has a District Chief Executive as the political leader. It has 5 communities and Wechiau as the capital of .the District. The District capital is about 15.0 km away from Wa Municipal by road. A large section of the Wa West district lives in smaller localities. In Ghana, a locality of less than 5000 persons is considered rural, (GSS, 2018), as such the district is categorized as rural. The District is primarily dominated by the Mole-Dagbani group, this comprises of the natives, Waala as well as the Sissala, Lobi and Dagaaba. The minority groups are the Ewes, Ga-Dangme, Guans and Akans. In addition, as it is common in most Ghanaian districts, there is a co-existence of local authorities such as chiefs and sub chiefs as well as formal governing body.

The local authorities comprise of paramount chiefs, lower-ranking chiefs, and the elders who are primary custodians of governing norms and traditional rules. However because human society is dynamic, there continues to be changes in this aspect of the people. There are also essentially spiritual leaders who aid in serving as intermediaries between men and gods and aid in sacrifices. They are known as the *tamdamba*. In Wa West, the District Assembly works in coalition with the central government to aid in the provision of social amenities such as irrigation, roads, electricity and schools.

3.2.2 Yilo-Krobo District

Figure 3.2 Map of Yilo Krobo Showing Selected Communities



Source: Extracted from district shapefiles of Ghana 2022

The Yilo Krobo district is one of the 33 districts in the Eastern Region. It attained its district status in 1988 and it is adjacent to the Greater Accra Region. According to the population census and the Ghana Statistical Service, the Yilo Krobo district Region is more urbanized and more

economically diverse and stronger than the Wa-West district. It is one of the key producers of Ghana's important cash crop, Cocoa and other food crops such as plantain, tomato, cassava and yam.

It was not possible to collect data from all communities in the Yilo Krobo district. Hence, three farming communities were selected; they were Obawale, Akorley and Huhunya.

3.2.2.1 Location and physical characteristics

Yilo Krobo district falls within the tropical forest climatic zone in the southwestern part of Ghana. It lies between latitude 60.00'N and 00.30'N and between longitude 00.30' and 10.00'W (GSS, 2010). It covers an estimated area of 805 km square with Somanya as the capital. Its south shares a border with Akuapim North District and its West with New-Juaben Municipal District, East Akim Municipal District and Fanteakwa District. The North shares a border with the Lower Manya Krobo district.

The area receives a substantial amount of rain, which is signified by two rainy seasons (April to July and September to November), with mean annual rainfall of 1600-1800 mm (Adu-Prah et al, 2019). Due to this, the district is suitable for trees such as palm, mango, nim, ceiba and acassia. As will be evident in Chapter 4, data from the Ghana Metrological Agency state that there has been a steady rise in temperature within the last 50 years. That is, a constant average of 0.027 annually over the last 50 years. Temperature ranges between a minimum of 24.90 and a maximum of 29.90. This indicates that contrary to popular opinions, the forest zone is gradually experiencing climate change. This is evident in the quality of crops provided over the years as will be highlighted from the focus group discussions captured in chapter 4.

3.2.2.2 Economic activities

The main economic activities in Yilo Krobo and the Eastern Region as a whole are agriculture (such as cash crop farming) and animal rearing such as goat and sheep, small-scale enterprises and services. According to the Ghana Statistical Service (2010), the main livelihood of the district is agriculture and this constitutes over 60% of households. Nonetheless, like the Upper West Region, agriculture in this region is largely rain-fed. Consequently, as pointed out in the Upper West, there are spatial disparities evident in the economic activities. However, Yilo Krobo is primarily rural with a few peri-urban centres, a large section of the rural populace engages in agriculture such as fishery, forestry and agriculture. The peri-urban populace engages in other forms of economic activities such as wholesale and retail as well as manufacturing. As is notable in most places in Ghana, there are gendered differentials in the types of livelihoods adopted. Women are more likely to engage in food crop farming as well as wholesale and retailing, whereas the men are more likely to engage in cash crop farming, forestry and fishery. Nonetheless, due to unfavorable and unstable rainfall patterns, most male farmers in the forestry have adopted crop farming or other forms of livelihoods that is considered feminine.

3.2.2.3 Demographic characteristics

According to the 2021 population census report, the Yilo Krobo is recorded to have a general population of 122 705. It comprises of 51.4% females (63 049) and 48.6 % males (59 656). It covers an area 514.7 kilometre square. It also has a population density of 238.4 km square. The district has experienced an annual population change of 3.2% between the years of 2010-2021.

Of these figures, 52.7 % (64 609) live in the rural areas and 47.3% (58 096) live in the urban centres. Like the Upper West Region, the Yilo Krobo district has a primarily youthful population

of 33.5% under 15 years (41 045) and 60.9 % between 15-65 years (74 695). 78.9% have had a form of formal education and 21.1% did not.

3.2.2.4 Political and social organization

The Yilo Krobo district is made up of migrants from other regions. Its location in the forest zone makes it an attractive destination for migrants. These migrants are usually from the Volta, Greater Accra and the Ashanti Regions. Though the Northern and Upper West Region contribute to the migrant population, the numbers are significantly lower due to distance between the regions.

The political system in Yilo Krobo is a mixture of tradition and formal authority, which operate together. There are two kinship systems existing in the Eastern Region, the patrilineal and matrilineal system. However, in Yilo Krobo the patrilineal system exists. Nonetheless, there seems to be an influence of the matrilineal system on the district in terms of female traditional leaders. These work in tandem with the district Assemblies for the provision of social amenities and in some cases, the provision of agriculture resources. For instance, the government in collaboration with MoFA has provided a new strain of mango seedlings in order to boost cash crop farming.

3.3 Philosophical Underpinning of the Research: Structuration Theory

This study seeks to examine the spatial and gendered dynamic of in-situ adaptation strategies and climate-related migration across two districts. In order to understand the complex interplay between space, gender and climate change responses, both formal and informal institutions like traditional norm and government policies could inform how these factors interact with each other (Gravesen et al, 2021). On this premise, Giddens (1984) structuration theory is selected as the probable philosophical perspective. Giddens (1984) structuration emerged as critique against the

humanist philosophies as well as the structural Marxist's ideals. The humanist approach believed that the action of actors in various societies were purely based on their intentions devoid of external influences (Bryant & Jary, 2014), whereas Structural Marxist believed that social actors' actions were strictly influenced by social and economic institutions (Holt-Jenson, 1999). According to Giddens (1984), these approaches were inadequate in explaining how certain individuals in society were not under the influence of the structures in place and in some cases able to influence these structures. An individual's capacity to be constrained, enabled or to reproduce structures by a certain degree of power is termed as human agency (Dyck & Kearns, 2006).

Based on this premise above, structuration theory has embedded in its core, principal concepts 'Structures' and 'human agency'. Giddens argues that though humans live in a society and are made up of structures that constrain them, there are instances where these structures empower the individuals (Canary & Tarin, 2017). He further argues that these are also influenced by the actions and inactions of the social actors.

The concepts of what constitutes structures and human agency have over the years been redefined. Holt-Jensen (1999) postulated that structures are not only institutions, but also a set of rules (Constraints) and resources (Capacities). Scholars like Sibeon (2004) viewed structures as not only rules, resources and institutions as implied by (Giddens, 1984 and Holt-Jensen, 1999). Sibeon (2004) further theorized that those structures are also a set of conditions that constrain or enhance the capacity of people to thrive or deteriorate in society. Sibeon (2004) also argued that these conditions included but not limited to power distribution and resources in society. He further suggested that other conditions may refer to other the actions and motives of other actors in society. Thus, the motives, actions, and capabilities of other actors in society could enable or constrain the capacity of an actor in society.

On the other hand, human agency is described as an actor's capability or inadequacy in that; it influences their own lives regardless of the constraints or the enablement of the social structures. Therefore, although the theory in its essence appreciates the influence of structures on human actions and activities, it also argues that the activities and actions of individuals are not only reliant on structures, but on a variety of social factors including resources and capacities as well as other social conditions. The theory further argues that the individual's capacity and resources termed as the human agency can equally influence these structures. The ability of structures to influence individual's activities and action as well as the acknowledgement of the human agency to influence structures has been termed as the 'duality of structures' (Giddens, 1984).

Despite the above use, the structuration theory has been criticized because of the potential difficulty that the researcher may face in plainly identifying structures in society especially non-observable structures (Stones, 2005). Nonetheless, the researcher in this study recognized that using the theory in tandem with the foresight and entitlement framework assists in the easy identification of non-observable structures like traditional gender norms as a result of the clarity of the structures in the frameworks.

In this study, the structuration theory will be appropriate for examining how different structures in the Ghanaian society and the study communities affect the adaptive capacity of men and women to deal with climate change. For instance, patriarchal norms, rules on gender roles, land inheritance systems, government agricultural policies, traditional institutions, and economic systems are structures which may enable or constrain men, women and the youth in adopting various climate adaptation strategies (Teye & Owusu, 2015). In the same way, climate related migration and immobility decisions as well as their outcomes can be influenced by various structures in society. In some instances, the male patriarch may take the decision on which household members should

migrate. Women may be ‘forced to remain’ to take care of children and elderly (Teye et al., 2017; Teye & Nikoi, 2022). However, structures do not strictly determine ability to adopt in-situ adaptation strategies and migration to deal with climate change. Certain individuals may depend on their own agencies to adopt various adaptation strategies or migration even when the prevailing structures constrain them from adopting these strategies (Awumbila et al., 2016).

The analytical strategy in this thesis will therefore be to examine the effects of both structures and agency of both men and women in adopting strategies to deal with climate change and migration.

3.4 Research design

The study employed the sequential explanatory mixed methods approach. This was adopted to mitigate the limitations associated with dichotomous approaches (Stern et al., 2021), by compensating for the weakness of individual methods (Cresswell & Merriman, 2011). The sequential explanatory method required the researcher to collect and analyse the quantitative data prior to the collection and analysis of the qualitative data (Almeida, 2018; Terrell, 2012). In this study, as established in the literature review and problem statement, climate change studies in Ghana has often focused on the Northern Savannah zone. Since the study was a triangulation of three-phenomenon, namely; climate change, gender and migration in two regions, the researcher believed that the qualitative data will contextualize and explain certain relevant variables which will have emerged from the quantitative findings (Almeida, 2018).

In the case of this study, the quantitative methods were efficient in measuring the hypothesis and offering a comparative perspective on the districts and gender. For example, it was useful in quantifying the number of male farmers who had adopted certain strategies as compared to female farmers. However, it was not able to distinctively contextualize what accounted for these

differences. The quantitative method was also useful in making certain generalisations relevant for the study. This included but was not limited to examine climate change and migration in both regions as well as statistically triangulating the relationship between migration, gender and climate change. On the other hand, the qualitative method was useful in understanding how the role of certain cultural structures such as traditional and inheritance norms played in how women and men adopted certain adaptation strategies.

Despite the outlined advantages many have criticized the mixed method design particularly, the sequential explanatory strategy to be time consuming since both phases are required for equal consideration (Terrell, 2012). Another key challenge is the cost involved in not only data collection but analysis and interpretation (Dawadi et al., 2021). Furthermore, the mixed method approach comprises of two distinct methods. These methods are from two epistemological backgrounds (Cresswell & Merriman, 2011; Morse, 2019). In light of this, the qualitative method is considered a subjective and unquantifiable approach, which discourages the contentious use of generalisations (Leech & Onwuegbuzie, 2009). On the other hand, the quantitative method is objective and quantifiable thereby encouraging the use of statistical generalizations (Stockemer et al., 2019).

Nevertheless, scholars like Mckim (2017) have argued for the dismissal of the dualistic narrative of the mixed method. This is primarily because they are both considered scientific in nature and have been proven useful for various research studies. Furthermore, they can be used simultaneously in certain instances to compensating for the weaknesses of the other (Plastow, 2016). In addition, there are key examples where one method validates the findings of the other. In this study, the quantitative method was used to analyse the gendered dynamics of climate change adaptation strategies. A further analysis of the quantitative data provided statistical evidence indicating that intensive irrigation was much more patronized by men in the communities under

study. However, the qualitative method using focus group discussions and in-depth interviews in both districts highlighted the advantage men often have in land accessibility due to traditional gender norms. Hence some of their irrigation could be financed by the sale of lands. This explained why more men patronized intensive irrigation as compared to women.

In Mckim (2017), it is argued that the use of the mixed methods approach is particularly useful in accessing the multi-faceted nature of social reality, hence bringing to the forefront all the varying dimensions that pertain to a specific social phenomenon. The researcher achieved this by utilizing the various tools synonymous to the two methods (Almalki, 2016; Tariq & Woodman, 2013). For instance regarding the use of qualitative methods, this study employed in-depth interviews and focus group discussion in the collection of data. It later used thematic analysis as a data analysis tool. These tools were useful in the documentation as well as the analysis of the perceived realities of the various social actors who needed to adapt to the effects of climate change. An example is highlighted in the use of the focus group discussions and in-depth interviews to understand the experiences, views, opinions and knowledge on the gendered impact of climate change on farmers from both farmers and key informants' perspectives. This is in lieu with Hirose & Creswell (2023) who asserts that qualitative method enables a researcher to gain insight to the influence and power relationships that informs the actions of social actors. This was a key component in understanding the varying motivations, constraints and access to resources and how they further informed migration decision-making of various social groups in the various study communities.

The use of qualitative method further explained the opposing views of men, women and the aged on the impacts of climate change and the effects on various social groups. It also brought into light how different government officials and extension officers viewed the phenomenon under study and this was not in tune to the needs of the people. For instance, in Akorley and Obaawale in the

Eastern Region, it emerged from focus group discussions and in-depth interviews that, the impact of climate change was felt and obvious through reduced crop yield as well as an increase of Bacterial Blackspot (BBS) on mango trees. This was validated by the findings from the quantitative study, which showed that within the last twenty years the Eastern Region had experienced an increase in temperature as well as erratic rainfall patterns. Nonetheless, the focus group unravelled how contrary to those in Siiru, Siriyiri and Dabo in the Wa West district, there were minimal planned adaptation strategies from the government. This showed how the social reality was different in two geographical spaces regardless of being affected by the same phenomenon.

3.5 Questionnaire survey

3.5.1 Questionnaire Design

Questionnaire was used to collect the required data from farmers and key informants from the six communities in the two districts where the study was carried out. This information included; bio data, knowledge and perception of climate change and variability, climate adaptation strategy, as well as migration and immobility. In order to test the viability of the questionnaire, some were distributed during a reconnaissance survey in November 2021. This was distributed among a small sample of farmers from each of the district in each of the region.

3.5.2 Sampling strategy and sample size

Sampling refers to the selection of a subset from a larger dataset in order to make an extrapolation of a whole population under a study (Sharma, 2017). That is taking a representative subset from a population in order to carry statistical analysis and draw potent conclusion about the whole

population. This is done with probability and non-probability sampling approaches. In this study, the researcher used random sampling in the selection of respondents for the quantitative study and purposive approach in the selection of communities and participants in the qualitative study. Since this is a mixed method study, the researcher had to take into consideration the sample sizes and sample schemes in order to reflect the quantitative and qualitative aspects of the study (Onwuegbuzie & Collins, 2017). This refers to the number of units selected and unambiguous process used in the selection of these units. In order to gather sufficient and appropriate information regarding sampling size for the study, the researcher undertook power analysis on both the quantitative and qualitative part of the research (Taherdoost, 2016).

In lieu of this, the study employed the multi-stage sampling strategy, blended with purposive and simple random in order to select the communities and the farmers under study. Simple randoming sampling was chosen as a result of the homogenous nature of the population that is, in terms of occupation and their similar socio-economic background. As highlighted earlier, this study is part of the Governing Climate Mobility project. Thereby the first phase required the researcher and other team members to list the communities under each district. Since the study aims to understand in-situ adaptation strategies, the researcher purposively selected farming communities, particularly those involved in food cropping, as they are more likely to be affected by climate change and variability. Given the multistage sampling approach, frames were implemented at each stage.

In the second stage, farmers in each house were listed by assigning them a number and a name, starting from one end of the community and numbering the houses. This was placed on a list. The researcher acknowledged the crucial role of gender balance in the selection of respondents. Thereby farmers were categorized by gender to explore gender dynamics, with emphasis placed

on selecting independent farmers—those who owned their own farms. Households with couples sharing a farm were not considered.

The third stage involved selecting respondents through randomized sampling. The numbered list was entered into a computerized system to randomly select respondents. If selected respondents were unavailable, the researcher visited up to three times before moving to the next person on the list.

3.5.3 Determination of sampling size

Determining the sample size is one of the key components of carrying out a research. This is because an undersize sample will fail to represent the reality of the general population, which would be a waste of time and resources. On the other hand, an oversize sample will also waste resources. Bearing this in mind, the researcher employed the use of the Yamane (1967) formula in the study, and targeted the confidence level of 0.05 i.e 95% and the confidence interval of 3. Therefore, deriving a sample size of 469 for the entire study, which comprised 230 respondents in the Yilo Krobo district and 239 respondents in the Wa West. Below is the Yamane (1967) formula utilized;

$$n = \frac{N}{1 + Ne^2},$$

Where n = correct sample size, N = Population size, e = Margin of Error (MoE), $e = 0.05$, and this is based on the Yamane research condition. In this study, $n=469$, where $N=594$ in the Wa West district in the Yilo Krobo, $n=230$ and $N=541$. According to Lakens (2022), the sample size and power estimation are required to substantiate a study and its conclusions. Hence, to maintain the power of the sample, the 469 households derived from the Yamane (1967) formula were distributed proportionally among the selected communities in the two districts. This was done

based on the number of households in the selected communities. The subsequent sections show the demographics of the sampled population.

3.5.4 Interviews

A semi-structured interview guide was developed and distributed among various farmers during focus group discussions and in-depth interviews. According to Chammas (2020) and Lokot (2021), key informants are people who are considered to be familiar with the social phenomenon under study and are willing to share their opinions, views and knowledge pertaining to a problem. For this study, 4 key informants from each district were selected. That is, one from each community and one from the district level.

Interviews conducted covered a range of topics such as climate change adaptation strategies for both men and women, migration decision by both men and women and traditional norms that constrained or encouraged migration. Some of the key informants included migrants and non-migrants. The selection of the informants was meant to gain an insight into what constituted one's decision to migrate and to assess the circumstances surrounding how one would stay. As a result of the varied backgrounds of the key informants, different interview guides were developed to suit the nature of questions for different intended respondents (Berman & Tyyskä, 2011). The target of the interview was for it to flow in a conversational tone in order to make the respondent comfortable whilst intentionally sticking to the topic at hand and deriving the required information (McIntosh & Morse, 2015). According to Clausen (2015), the interviewees often do not want to feel like they are being cross-examined by handling an onslaught of questions. The researcher therefore, took into consideration that "interviewing is a transaction, a bargain between two consenting adults" (Hammer & Wildavsky, 2018, p. 63). However, in order not to lose sight of the

interview and to maintain neutrality, the researcher did not express beliefs or reveal personal views (Magaldi & Berler, 2020) this was to maintain control over the interview.

Consequently, in order to gain a gendered perspective of the phenomenon, male and female farmers of various age groups and from different backgrounds were interviewed (Newcomer et al., 2015). This was a pre-requisite to gaining a thorough insight into how climate change affected different social groups and how gender role informed one's adaptive capacity. This was also to highlight how gender norms influenced men and women's adaptation strategies. From the interviews, it was realized that the social space one occupied could influence one's decision-making. For instance, in communities studied in the Eastern region, it was gathered that women were likely to migrate as compared to the Upper West where women were discouraged. However, from field interviews, it was gathered that men were more likely to adopt in-situ adaptation strategies. This is as a result of traditional inheritance systems which give them access of resources such as lands that could be sold to finance strategies like irrigation and the use of machinery (Adzawla et al., 2019).

Another key observation, from the field was that interviews from key informants (government officials) was in contrast to data collected from the farmers who in the opinion of the researcher had given an unsatisfactory explanation of the issue. This further tallies with the assertion that key informants may provide a lopsided perspective on a social problem (Lupu & Michelitch, 2018). Hence, it was imperative that a researcher includes other research tools in the collection and analysis of data (Willson & Miller, 2014).

A semi-structured interview guide was used to interview farmers, migrants as well as MCEs of the districts under study. Even so, the researcher acknowledges that the use of semi-structured

interviews could be strenuous, time-consuming as well as required a certain level of interviewer sophistication (Adams, 2015). However, it was the belief of the researcher that the use of the semi-structured interview guide served as a means of gaining individual thoughts of farmers on climate change, especially during the reconnaissance stage, as well as tease out the varying perspectives of the diverse social group under study whilst making room for various topics (Ahlin, 2019). In order to gather relevant information during the interview process, the interview was recorded with a recorder. This was to get what was said verbatim. However, the researcher was aware that the use of a recorder could influence the behavior of a respondent by either intimidating or influencing how he answered some questions (Hammer & Wildavsky, 2018). The researcher was equally aware of other problems that could emerge as result of recording the interview; this included, but was not limited to background noise, poor machinery and low batteries (Tessier, 2012). To overcome this, the researcher ensured that permission was sought from the respondents. Whilst assuring anonymity, the researcher explained that the interview was recorded to get details of the narrative in the interviewee's own words (Oltmann, 2016). The researcher further ensured that the recorder was in good condition and had enough batteries whilst insisting on conducting the research in a serene environment. Additionally, the researcher wrote down outstanding observations and yet included themes that unintentionally emerged from the interview. For instance, the researcher observed the sense of abandonment the people of Akorley had towards the government. This served as an insightful and predominant asset for the study since the interview assisted as an outlet for them to voice out their frustration (Roulston & Choi, 2018). As stated by (Hammer & Wildavsky, 2018, p. 67), "most people are quite willing to give interviews. Interviewing may fulfill ego needs of the respondent (the need for recognition, for feeling needed

or important), the interview may be cathartic, allowing the informant to get something off his mind, or interviewing may be satisfying because of the psychic need for interaction.”

Fortunately, none of the contacted respondents declined an interview or refused to be recorded. However, what was noted was the constant absence of officials from their offices. This resulted in the officers requiring a constant chase in securing an interview with them. Though exasperating, eventually getting an interview proved insightful as it helped in shedding light on the government’s interventions or inactions in reference to the effects of climate change.

One aspect that the researcher finds imperative to mention is the undocumented yet useful interviews that took place during reconnaissance survey. This introduced and showed the researcher potential respondents as well as the socio-economic setting to be expected. For instance, the researcher had become quite familiar with a few community members as well as a few of their farms; hence it enabled a level of familiarity that encouraged a smooth flow of conversation. This could illustrate how and why respondents were willing to answer especially in the Eastern Region.

3.5.5 Focus group discussions

According to Clarke and Braun (2013), a focus group discussion is a meeting of respondents often from the same social group to discuss a particular topic pertaining to a precise topic under study. The meeting is often structured and moderated by the researcher who chooses the topic of discussion (King & Hugh-Jones, 2018). Three focus group discussions were organized in the three communities. The focus groups comprised of men only, women only and youth only. This research tool was useful in accessing the various thoughts as well as perspectives on the gendered impacts of climate change in a public setting. Often, these discussions bring out different perspectives that are often challenged by another. For example, when asked if indeed there were gendered impacts

of climate change, both men and women agreed that there were gendered differentials. However, the men argued that it affected them a lot more since they had to provide money and food for their families. However, this was debunked by the women, who argued that they were impacted more since they were the primary caretakers of children.

3.6 Secondary data sources

The study required that the researcher derived data from sources as such population census report, IOM report as well documents from respective districts under study. This in most cases served as a source of background information for the study as well as the three variables under study, climate change, gender and migration.

3.6 Data analysis

Data collected were analyzed depending on whether it was qualitatively or quantitatively. In regard to the qualitative methods, data was collected via in depth interviews and focus group discussions. Transcripts were first transcribed and analysed via the use of intense thematic analysis. In reference to the quantitative data, data collected via questionnaire survey were analysed with the use of SPSS, which demonstrated the results with the use of frequency tables, pie and bar charts to show the migration trends. A statistical tool like the chi square was used to show the correlation between multivariate variables such as age, gender and adaptation strategies, whereas quotations from the qualitative text were used to expatiate and highlight the socio-economic effects or implications of the statistical analysis.

3.7 Ethical consideration

As per the regulations of the graduate school of the University of Ghana, the required guidelines for ethical consideration as demanded by the social sciences were considered. As such, the researcher filled out the ethical consideration form before proceeding with data collection. This was to cover grounds and concerns related to confidentiality, participation and consent. Thus, before the collection of data, respondents were first informed about the purpose of the research. Anonymity was also assured. Therefore, data was collected with the consent of all concerned. In the transcription of qualitative data, names and places were anonymized to hide the identity of respondents for reasons of confidentiality.

3.8 Reflections on researcher positionality

According to Qin (2016) and Holmes (2020), a researcher's positionality is pertinent in accessing the viewpoint as well as the validity of the study. Such as the way a phenomenon is looked at and interpreted, this includes the influence of the researcher's background, experiences, and predispositions on the research method and results. Thus, the imperativeness of stating the positionality of the researcher as well as the participants cannot be ignored. According to Collins and McNulty (2020), the researcher's age, gender, educational and class background can influence the access to respondents, as well as how data are collected and interpreted. Likewise, the researcher's age, gender, educational, class, background could influence how data is given and how the researcher is assessed.

For instance, during the reconnaissance survey, potential participants were a bit skeptical to voice out their concerns when questions were asked. It was observed that participants in the Akorley and Obaawale in the Yilo Krobo district were much more receptive with the researcher as compared

to those in the Wa West district. As was noted in the problem statement and chapter two, most climate change studies have focused on the North Savannah zone with little or no studies being undertaken in places like the eastern region. As such, farmers in the Yilo Krobo district were more eager to partake in the discussion initially thinking this was a government programme, and then later willing to partake in this because they believed this was the best conduit to reach out to the government officials as well as voice out their frustrations.

Regarding the key informants' interviews, in both districts, they were interested in partaking in the research particularly when they realized that I was a student engaging in a research of such magnitude. This prompted conversations that were not in connection to the topic under study. However, for the sake of getting the necessary information, the researcher partook in the conversation as suggested by (Adeoye-Olantude & Olenik, 2021). Nevertheless, one key aspect of the researcher's positionality was that most of the government officials were much more interested in not implicating the government in some of the issues raised. These included explaining the inadequate government intervention programmes on climate change in the Eastern region.

Another group was the agriculture extension officers who equally tried to apportion blame to their superiors and tried to not implicate themselves in their inability to reach out to the farmers. Nonetheless, due to the incorporation of various research tools, the researcher believes in the high replication and validity of the research.

3.9 Limitations and challenges of the study

Collection of data was relatively easy in the eastern region, since the topic of climate change was often studied in the Northern Savannah zone of Ghana without attention in the tropic Forest zone. This encouraged most respondents in the Yilo Krobo district to readily participate in the research. According to them, this was probably a means for them to get their worry across. However,

interview with the DCE and other key informants proved to be a bit of a hurdle since most were absent from their offices especially on a hot Friday afternoon. In the Upper West region, there were some issues of research fatigue where it took lot of time convincing participants to participate. This was because most believed that their continuous participation in such research activities did not yield productive output. According to Ashley (2021), research fatigue occurs when a group of people in a particular space refuse to be researched due to emotional or psychological exhaustion. In order to tackle this, the researcher decided to show all forms of identification as well as provide details on the purpose of the study. This curtailed further outburst, dissuaded the false perception that the researcher was from the government, yet encouraged them and assured them of the importance and relevance of their answers to the contribution of knowledge and the shaping for future policies.

This highlighted the geographical disparities in how government tackled climate change issues in Ghana. On one hand, respondents in the Yilo Krobo district were much more enthusiastic to meet the researchers; this was partly fueled by rage to confront them as they were mistaken to be government officials who had neglected the people. On the other hand, respondents in the Wa West district tried to avoid the researchers since they believed that the phenomenon had been over studied in that particular space.

Another clear limitation of the study was that, key informants needed to portray themselves in a positive light whilst trying to steer clear away from the issues raised in the interview.

Additionally, there was only one weather station located in the Wa Municipal area, which was used to gather climatic data for the Wa West District. The researcher acknowledges that it would have been more prudent to have a dedicated weather station within the Wa West District itself; however, this was not available.

CHAPTER FOUR

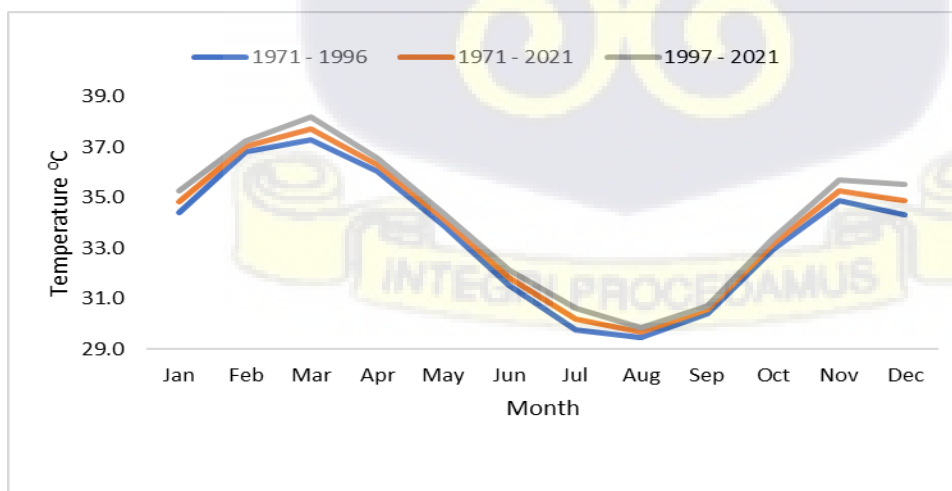
LOCAL FARMERS PERCEPTION OF CLIMATE CHANGE

4.1 Introduction

Chapter Four focuses on the long-term changes in climate and the local people’s perception and experiences of climate change. The graphs were created by the researcher using fifty years of data obtained from the Ghana Meteorological Service. The researcher analyzed this climate data and compared it with respondents’ perceptions of climate change. This is to determine if changes in climate are in accordance with what the respondents perceive. This the researcher believes will answer research question 1: are local people’s perception of climate change consistent with scientific data? The chapter further examines the effects of temperature changes as well as changes of rainfall patterns on livelihoods. This will be done with the use of bivariate and multivariate analysis.

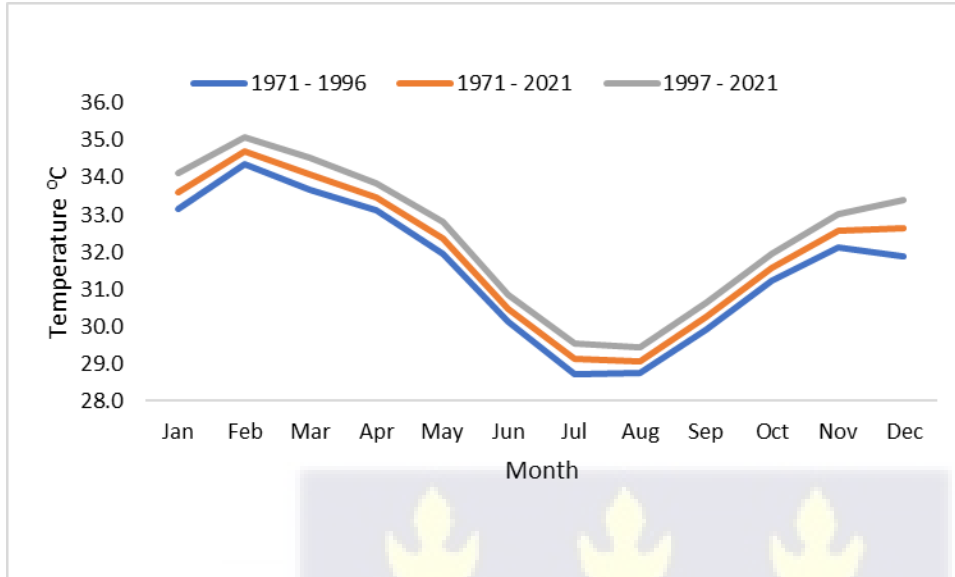
4.2 Long term changes in temperature based on meteorological data

Figure 4.1: Mean monthly maximum temperature T_x for Wa



Source: Ghana Metrological Agency (2021)

Figure 4.2: Mean monthly maximum temperature Tx for Yilo Krobo

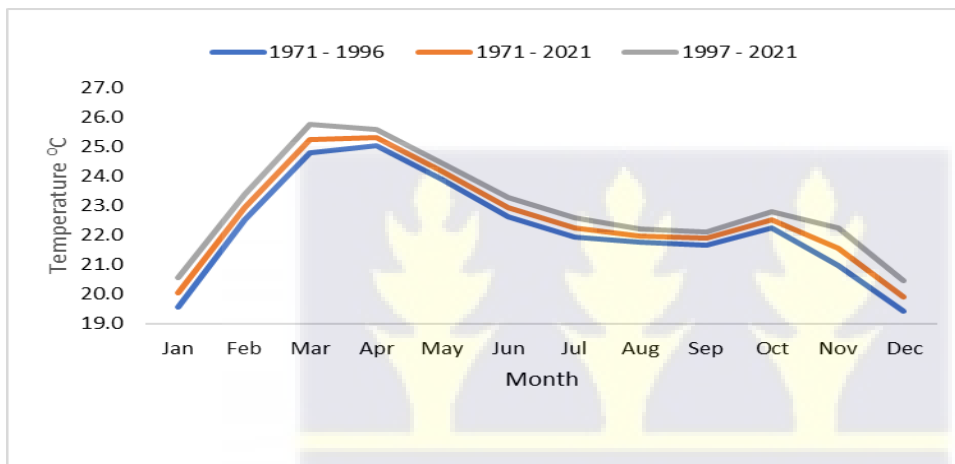


Source: Ghana Metrological Agency (2021)

From the above diagrams, we can deduce that, the mean monthly maximum temperature for both Wa and Yilo Krobo has increased over the period analyzed. This is in consonance with the temperature projections over West Africa from global climate simulations (Conway et al., 2019). The diagrams further show that for Wa, the highest mean monthly maximum temperature for the period (1971 – 1996) was at a value of 37.3°C, recorded in the month of March and has since risen to 38.2°C, in the (1997 – 2021) period, an increase of approximately 0.9°C. For Yilo Krobo, the analysis shows an increase of 0.4°C, this is from 34.7°C within (1971 – 1996) to 35.1°C in the (1997 – 2021) period which was recorded in the month of February. This makes March and February the warmest months for Wa and Yilo Krobo respectively. The differences in the increase also imply that the temperatures in Wa are increasing faster than Yilo Krobo. Although this has a variety of implications on the climate and livelihood of both locations, Wa stands to be more

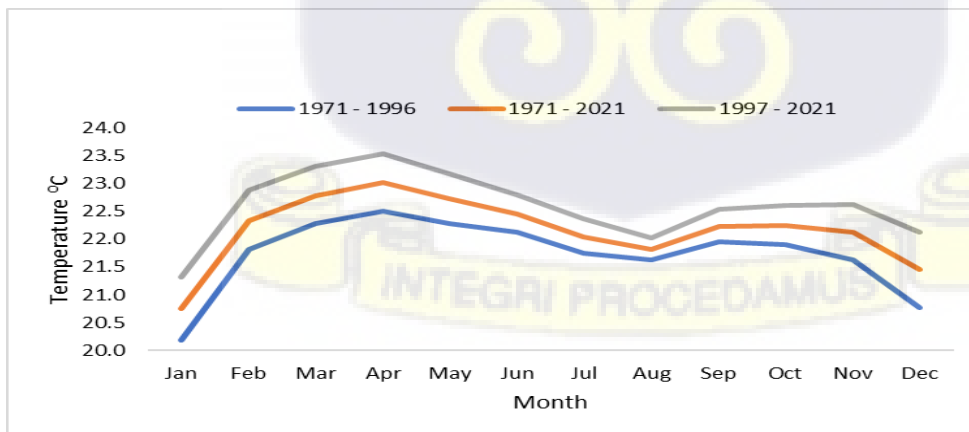
vulnerable because of the sharpness of the increase. Normally, temperatures for Wa are higher than temperatures for Yilo Krobo because the two locations are in completely different climate regimes. While Wa is located in the hot and dry climatic zone, often marked by hot temperatures and dry atmospheres, Yilo Krobo is located in the warm and humid climatic zone, marked by warm temperatures and high levels of humidity.

Figure 4.3: Mean monthly minimum temperature Tn for Wa



Source: Ghana Metrological Agency (2021)

Figure 4.4: Mean monthly minimum temperature Tn for Yilo Krobo

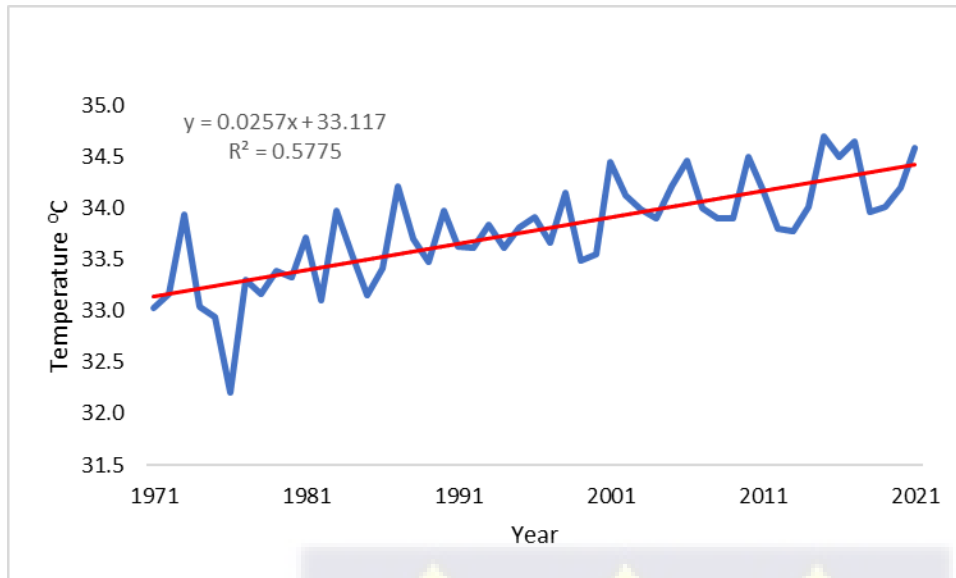


Source: Ghana Metrological Agency (2021)

Figures 4.3 and **4.4** depict the mean monthly minimum temperature for Wa-West and Yilo Krobo respectively. An increase is observed from the 1971 – 1996 mean temperatures to that of 1997 – 2021. The highest mean minimum temperature for Wa was 25.7°C recorded in the month of March within 1997 – 2021 on the average which is an increase from 24.8°C in the 1971 – 1996 average. The lowest mean minimum temperature was 19.4°C recorded in the 1971 – 1996 average for the month of December and has since increased to 20.4°C in the 1997 – 2021 average. For Yilo Krobo, the data reveal that the highest mean minimum temperature was 23.5°C which was an increase from 22.5°C recorded in the 1971 – 1996 average in the month of April. The lowest minimum temperature was 20.8°C recorded in the 1971 – 1996 average for the month of January and in the 1997 – 2021 average, this value had increased to 21.3°C. A key observation to note here is that while the highest mean minimum temperatures for Wa are higher than that of Yilo Krobo, the lowest mean minimum temperatures are lower. The topography or the nature of the land surface of Wa explains this phenomenon. Minimum temperatures are recorded in the evening and temperature loss on land surfaces with little vegetation is faster than land surfaces with higher vegetation cover. Wa has less vegetation cover than Yilo Krobo and therefore, will record lower temperatures in the evening than Yilo Krobo.

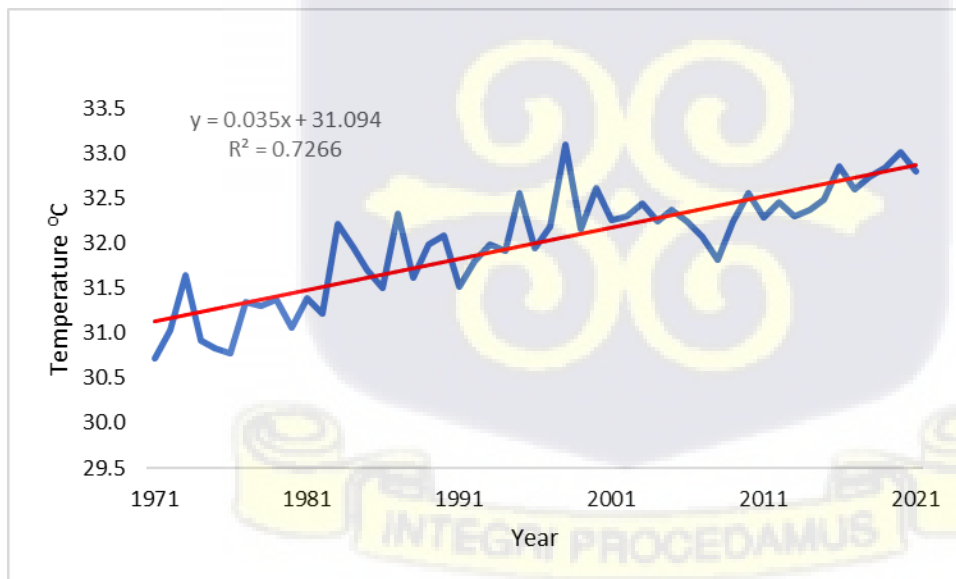
From **Figures 4.5** and **4.6**, we can deduce that both Wa and Yilo Krobo have an upward or increasing long term maximum temperature trends. The redline indicates the trend line which has a slope of 0.0257 for Wa and 0.035 for Yilo Krobo. These values indicate the rate at which temperatures have been increasing on yearly basis.

Figure 4.5: Maximum temperature timeseries for Wa



Source: Ghana Metrological Agency (2021)

Figure 4.6: Maximum temperature timeseries for Yilo Krobo

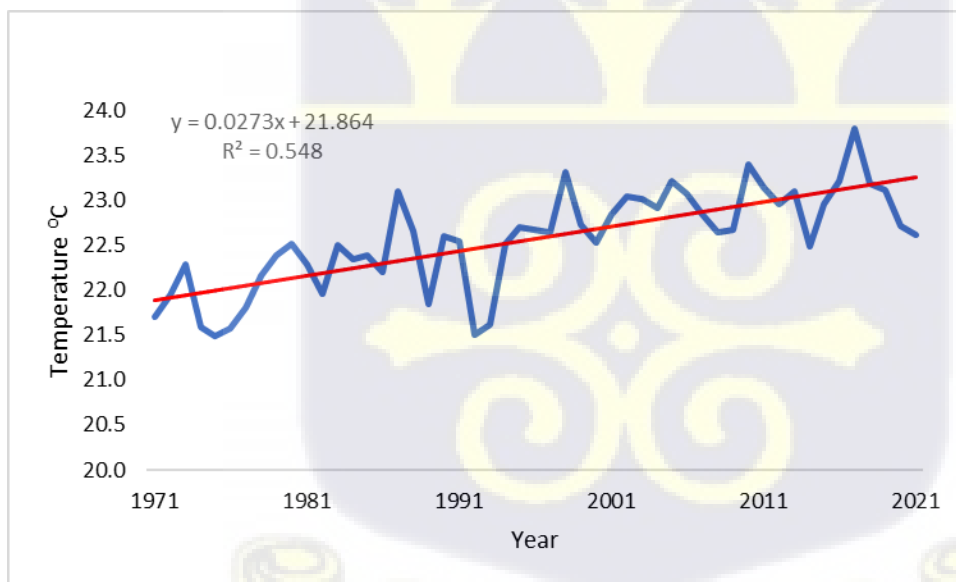


Source: Ghana Metrological Agency (2021)

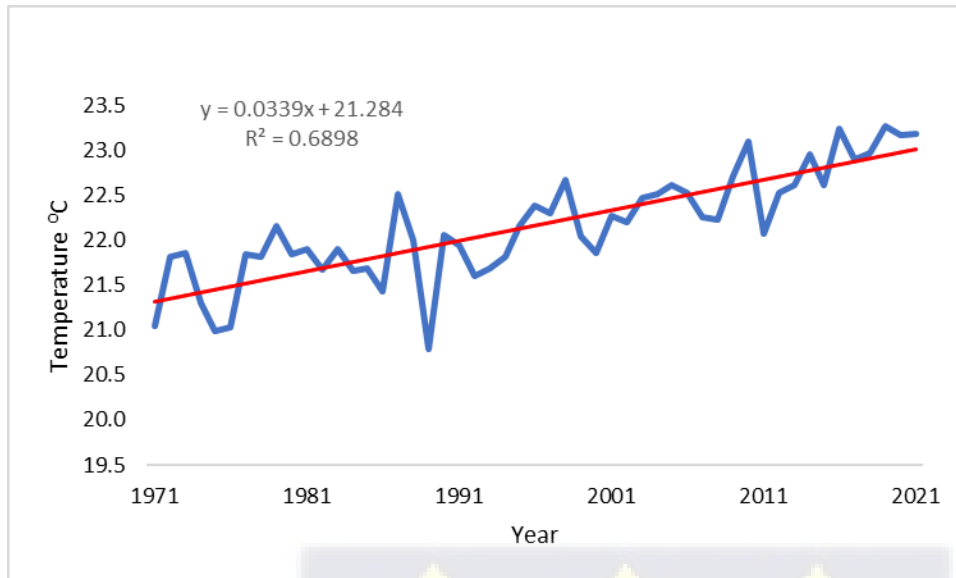
Therefore, for Wa, temperatures are increasing at 0.0257°C every year and for Yilo Krobo, 0.035°C every year. This further implies that maximum temperatures are increasing at a faster rate for Yilo Krobo than for Wa. This could be attributed but not limited to changing land use, deforestation or loss of water bodies in the region.

The empirical analysis of the long-term dataset reveals that the temperatures for Wa have a Coefficient of Variation (CV) of 1.50%, while Yilo Krobo has a CV of 1.91%. This implies that the maximum temperature over Yilo Krobo has a higher inter-annual variation than that of Wa. Inter-annual variation measures the variation of the dataset relative to the mean temperature of the entire dataset.

Figure 4.7: Minimum temperature time series for Wa



Source: Ghana Meteorological Agency (2021)

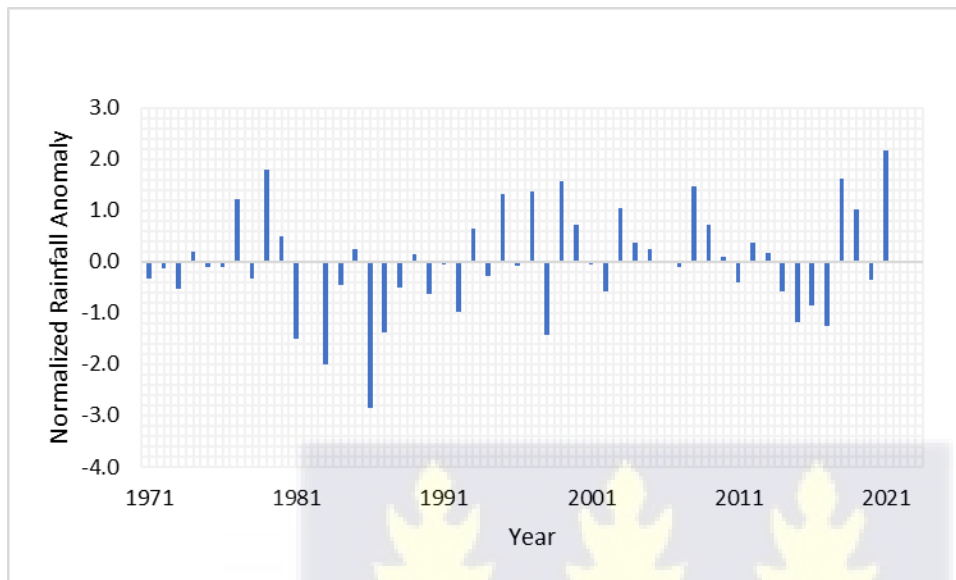
Figure 4.8: Minimum temperature timeseries for Yilo Krobo

Source: Ghana Metrological Agency (2021)

From **Figures 4.7** and **4.8**, it is observed that both Wa and Yilo Krobo have an upward minimum temperature trend. The trend line for Wa has a slope of 0.0273, and for Yilo Krobo, a slope of 0.0339 is calculated. This, therefore, indicates that for Wa, temperatures are increasing at 0.0273°C every year and for Yilo Krobo, it is 0.0339°C yearly. This suggests that minimum temperatures are also increasing at a faster rate for Yilo Krobo than for Wa. Again, this could be attributed to land use change, deforestation or loss of water bodies in the region. The empirical analysis of the long-term dataset reveals that the temperatures for Wa have a Coefficient of Variation (CV) of 2.39%, while Yilo Krobo has a CV of 2.73%. This implies that the minimum temperatures over Yilo Krobo have a higher inter annual variation than that of Wa.

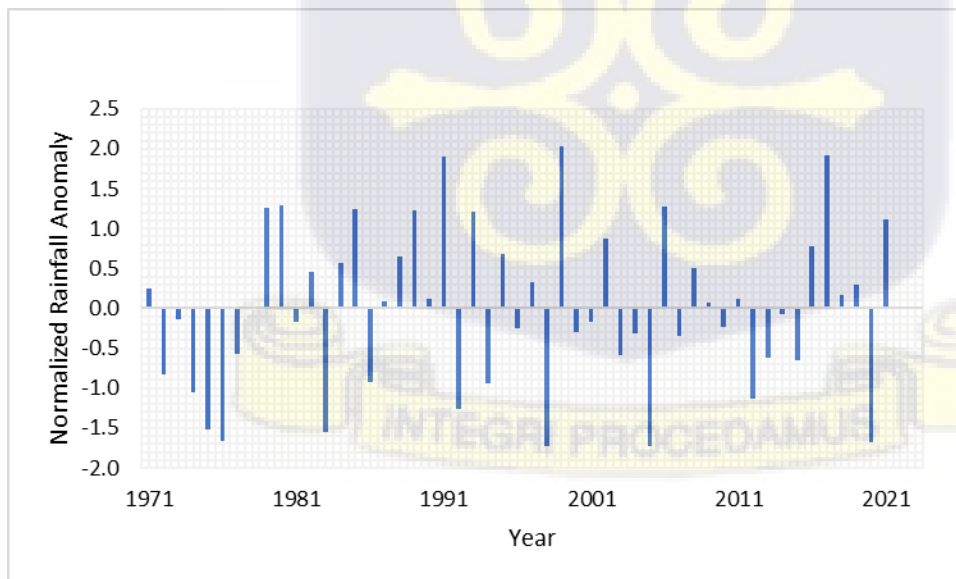
4.3 Long term changes in rainfall

Figure 4.9: Normalized Rainfall Anomaly for Wa (1971 – 2021)



Source: Ghana Metrological Agency (2021)

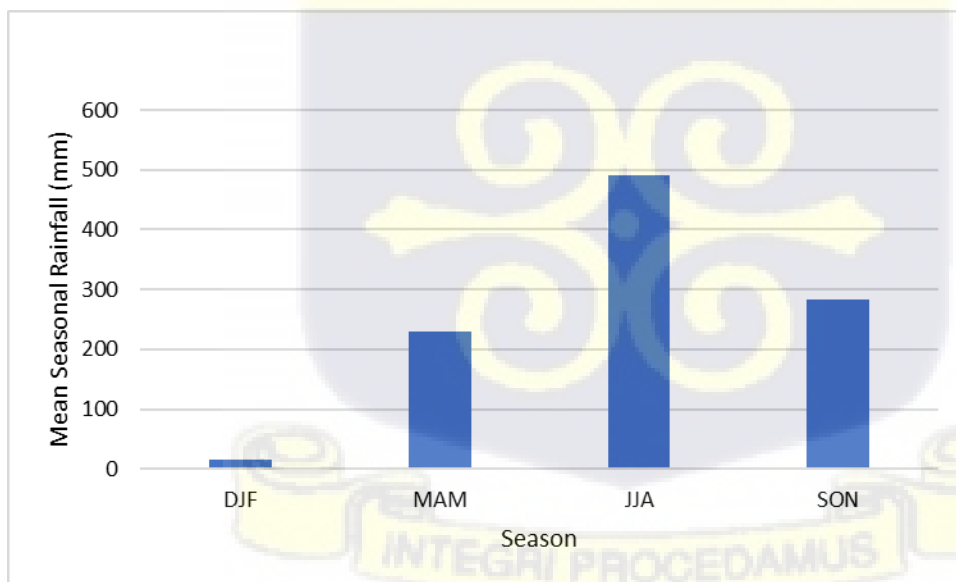
Figure 4.10: Normalized Rainfall Anomaly for Yilo Krobo (1971 – 2021)



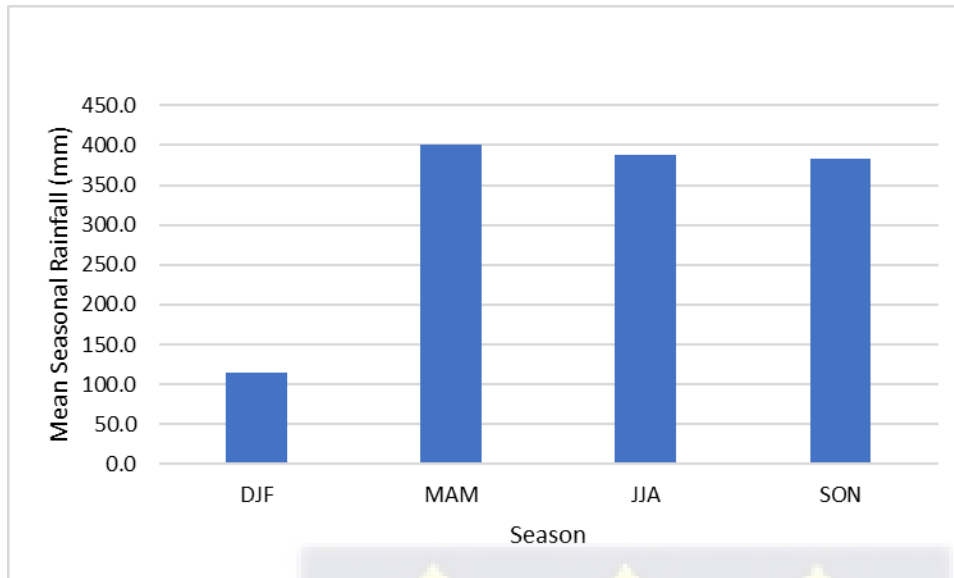
Source: Ghana Metrological Agency (2021)

Normalized rainfall anomaly reveals the deviation of annual rainfall values from the calculated annual mean. From Figure 4.10, there's a clear extended period of rainfall deficit between the years of 1980 and 1992 after which we again observe a period of rainfall increase. The years following 2011 also reveal a period of dryness until in 2018, where the pattern changes to rainfall excess. The nature of this pattern would have an impact on water availability and the drought severity, hence affecting the livelihood choices and decisions of the community. The annual rainfall mean for Wa was seen to be 1016.1mm. The rainfall in Yilo Krobo rather shows a very high inter annual variability greater than that of Wa. However, some periods of dryness can be observed between 1971 – 1978 and 2010 – 2015. The annual mean for Yilo Krobo was calculated to be 1283.1mm, which is higher than that of Wa. Yilo Krobo has a bimodal rainfall regime and so receives more rains annually as compared to Wa, which has a unimodal rainfall regime (Aryee et al., 2017).

Figure 4.11: Seasonal rainfall distribution, Wa 1971 – 2021.



Source: Ghana Metrological Agency (2021)

Figure 4.12: Seasonal rainfall distribution, Yilo Krobo 1971 – 2021.

Source: Ghana Metrological Agency (2021)

The seasonal rainfall distribution for Wa and Yilo Krobo are displayed in **Figures 4.11** and **4.12** respectively. The months of June, July and August (JJA) representing the summer months record the highest amount of rain for Wa, followed by September, October and November (SON) and March, April and May (MAM). However, for Yilo Krobo, the March, April, May (MAM) months representing the spring months record the highest rainfall, the distribution is relatively even for JJA and SON. It appears, therefore, that rainfall is more evenly distributed throughout the year for Yilo Krobo than for Wa. Per this distribution, the former will have more water security and availability all year round than the latter. The figures further suggest that Wa has a unimodal rainfall modality (a wet season without any dry months) agreeing with (Herrmann & Mohr, 2011)'s classification of rainfall seasonality regimes across Africa and (Aryee et al., 2017), while Yilo Krobo is approaching a multimodal rainfall modality (a rainfall season with more than two peaks separated by dry months) contrary to most estimations. The seasonal variability is determined by calculating the CV of the seasonal distribution of the rainfall amounts. For Wa West, it was found

to be approximately 130% and for Yilo Krobo, 232%. This implies that the seasonal variation of rainfall is higher for Yilo Krobo than for Wa West.

4.4 Demographic Distribution of Sampled Population

Table 4a: Age distribution of sampled population

Age	Yilo Krobo			Wa West			All		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
18 – 25	9 (7.4)	10 (9.2)	19 (8.3)	12 (9.8)	8 (6.8)	20 (8.4)	21 (8.6)	18 (8)	39 (8.3)
26 – 35	24 (19.8)	26 (23.9)	50 (21.7)	27 (22.1)	34 (29.1)	61 (25.5)	51 (21)	60 (26.5)	111 (23.7)
36 – 45	40 (33.1)	39 (35.8)	79 (34.3)	45 (36.9)	28 (23.9)	73 (30.5)	85 (35)	67 (29.6)	152 (32.4)
46 – 55	22 (18.2)	17 (15.6)	39 (17)	20 (16.4)	26 (22.2)	46 (19.2)	42 (17.3)	43 (19)	85 (18.1)
56+	26 (21.5)	17 (15.6)	43 (18.7)	18 (14.8)	21 (17.9)	39 (16.3)	44 (18.1)	38 (16.8)	82 (17.5)
Total	121(100)	109(100)	230(100)	122(100)	117(100)	239(100)	243(100)	226(100)	469 (100)
	$\chi^2 = 2.0495, Pr = 0.727$			$\chi^2 = 6.4738, Pr = 0.166$			$\chi^2 = 2.9305, Pr = 0.570$		

Source: Fieldwork, 2022

There was a total of 469 respondents across the two regions who partook in the survey. Of this number, 230 respondents were in Yilo Krobo and 239 in Wa West. Regarding gender, 121 males in the Eastern Region responded to data as compared to 109 women. This was expected as pointed out in Chapter 3 since women were of a greater percentage in the region than the men were (GSS, 2021).

In Wa West, 122 men answered as compared to 117 women. However, like in Yilo Krobo, the only time women respondents were more than men, was found in respondents within the age group of 26-35 year old where women accounted for 29.1% and men, 22.1%. However, respondents between the age group of 36-45 years accounted for the largest sect of respondents in the Wa West district.

4.4.1 Level of Education

Table 4b: Level of Education

Level of education	Yilo Krobo			Wa West			All		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
No formal education	12 (9.9)	27 (24.8)	39 (17)	61 (50)	81 (69.2)	142 (59.4)	73 (30)	108 (47.8)	181 (38.6)
Primary	14 (11.6)	16 (14.7)	30 (13)	23 (18.9)	15 (12.8)	38 (15.9)	37 (15.2)	31 (13.7)	68 (14.5)
Junior Middle School	68 (56.2)	57 (52.3)	125 (54.3)	14 (11.5)	12 (10.3)	26 (10.9)	82 (33.7)	69 (30.5)	151 (32.2)
SHS /'A'level	19 (15.7)	6 (5.5)	25 (10.9)	15 (12.3)	7 (6)	22 (9.2)	34 (14)	13 (5.8)	47 (10)
Vocational	1 (0.8)	3 (2.8)	4 (1.7)	2 (1.6)	2 (1.7)	4 (1.7)	3 (1.2)	5 (2.2)	8 (1.7)
Tertiary	7 (5.8)	0 (0)	7 (3)	7 (5.7)	0 (0)	7 (2.9)	14 (5.8)	0 (0)	14 (3)
Total	121 (100)	109 (100)	230 (100)	122 (100)	117 (100)	239 (100)	243 (100)	226 (100)	469 (100)
	$\chi^2 = 21.0618$ Pr = 0.001			$\chi^2 = 14.4658$, Pr = 0.013			$\chi^2 = 31.7250$, Pr = 0.000		

Source: Fieldwork, 2022

Within the domain of education, 38.6% of both male and female respondents across districts have had no formal education. This constituted 47.8% women and 30 % men. As shown in the table, 17% of respondents in Yilo Krobo district did not have formal education as compared to 59.4 % in the Wa West district. This was expected as the district was reported to have the lowest literacy rate in Ghana (GSS, 2021).

When differentiated by district, 9.9% males in Yilo Krobo district as compared to 24.8% females had no formal education. This is in sharp contrast and comparatively lower to the Upper west Region where a significantly higher level of females (69.2%) had no formal educational as compared to 50% males. This was not unexpected since reports such as the GSS report (2021) highlights the overall educational disparity that exists between Upper West region and other

regions. However literary works such as (Obikili, 2015), sheds light on the gender disparity to education in the Wa West district. This is attributed to the strict traditional gender roles and norms. In instances where there is access to education, most women do not acquire higher education as is evident in the data above. Statistical analysis shows that 3% of individual across regions had tertiary education yet 0% of this percentage were women.

4.4.2 Marital status

Table 4c: Distribution of Marital Status

Marital Status	Yilo Krobo			Wa West			All		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Married	68 (56.2)	51 (46.8)	119 (51.7)	103 (84.4)	98 (83.8)	201 (84.1)	171 (70.4)	149 (65.9)	320 (68.2)
Single	23 (19)	13 (11.9)	36 (15.7)	18 (14.8)	5 (4.3)	23 (9.6)	41 (16.9)	18 (8)	59 (12.6)
Divorced/ Separated	9 (7.4)	11 (10.1)	20 (8.7)	1 (0.8)	2 (1.7)	3 (1.3)	10 (4.1)	13 (5.8)	23 (4.9)
Cohabitat ion	16 (13.2)	19 (17.4)	35 (15.2)	0 (0)	2 (1.7)	2 (0.8)	16 (6.6)	21 (9.3)	37 (7.9)
Widowed	5 (4.1)	15 (13.8)	20 (8.7)	0 (0)	10 (8.5)	10 (4.2)	5 (2.1)	25 (11.1)	30 (6.4)
Total	121 (100)	109 (100)	230 (100)	122 (100)	117 (100)	239 (100)	243 (100)	226 (100)	469 (100)
$\chi^2 = 10.0648, Pr = 0.039$				$\chi^2 = 19.7096, Pr = 0.001$			$\chi^2 = 24.2946, Pr = 0.000$		

Source: Fieldwork, 2022.

To further understand the demographics of the respondents, the study sought to find out the marital status of respondents involved in the study. The above table indicates that 68.2% of respondents across districts were married followed by 12.6% single and 7.95% were co habiting and 4.95% divorced. When differentiated by districts, a significant lower percentage of respondents in Yilo Krobo (51.7%) were married compared to 84.1% of respondents from Wa West.

In exploring the gender variable, it is shown in the table above that 65.9% of women were married across regions paralleled to 70.4% of men. In each district however, Wa West had 83.8% of women married as compared to 84.4% of men. This is in contrast to 51.7% of respondents in Yilo Krobo who were recorded as married, constituting 46.8% women and 56.2% men.

4.4.3 Main Source of Livelihoods

Table 4.d: Distribution for Main Source of Livelihoods

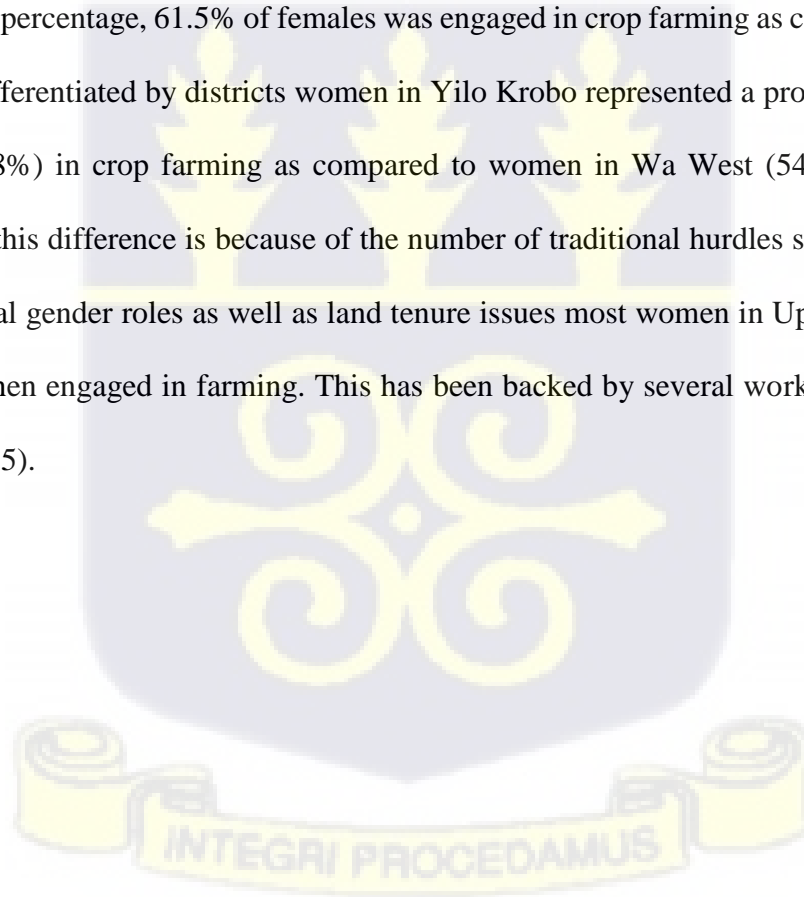
Main Livelihood Source	Yilo Krobo			Wa West			All		
	Male N (%)	Female N (%)	Total N (%)	Male N (%)	Female N (%)	Total N (%)	Male N (%)	Female N (%)	Total N (%)
Crop Farming	104 (86)	75 (68.8)	179 (77.8)	85 (69.7)	64 (54.7)	149 (62.3)	189 (77.8)	139 (61.5)	328 (69.9)
Animal Husbandry	0 (0)	1 (0.9)	1 (0.4)	7 (5.7)	1 (0.9)	8 (3.3)	7 (2.9)	2 (0.9)	9 (1.9)
Land Rents	2 (1.7)	0 (0)	2 (0.9)	1 (0.8)	0 (0)	1 (0.4)	1 (0.4)	0 (0)	1 (0.2)
Trading/Commerce	1 (0.8)	24 (22)	25 (10.9)	5 (4.1)	24 (20.5)	29 (12.1)	2 (0.8)	0 (0)	2 (0.4)
Civil servant	3 (2.5)	0 (0)	3 (1.3)	3 (2.5)	1 (0.9)	4 (1.7)	6 (2.5)	48 (21.2)	54 (11.5)
Business Employment	2 (1.7)	2 (1.8)	4 (1.7)	1 (0.8)	1 (0.9)	2 (0.8)	6 (2.5)	1 (0.4)	7 (1.5)
Skilled labour (mason, carpenter, mechanics)	6 (5)	5 (4.6)	11 (4.8)	16 (13.1)	13 (11.1)	29 (12.1)	3 (1.2)	3 (1.3)	6 (1.3)
Unskilled Labour	1 (0.8)	0 (0)	1 (0.4)	3 (2.5)	6 (5.1)	9 (3.8)	22 (9.1)	18 (8)	40 (8.5)
Remittances	2 (1.7)	1 (0.9)	3 (1.3)	0 (0)	5 (4.3)	5 (2.1)	4 (1.6)	6 (2.7)	10 (2.1)
Other	0 (0)	1 (0.9)	1 (0.4)	1 (0.8)	2 (1.7)	3 (1.3)	2 (0.8)	6 (2.7)	8 (1.7)
Total	121 (100)	109 (100)	230 (100)	122 (100)	117 (100)	239 (100)	1 (0.4)	3 (1.3)	4 (0.9)
	$\chi^2 = 33.7483, Pr = 0.000$			$\chi^2 = 28.4595, Pr = 0.001$			$\chi^2 = 52.8911, Pr = 0.000$		

Source: Fieldwork, 2022

Table 3.4 shows the economic activities of the respondents. The main source of livelihoods across regions was crop farming 69.9%. This was not unexpected since 60% of the country's population had agriculture as some form of livelihood (GSS 2021). The next common source of livelihood was civil servants 11.5% and unskilled labour 8.5%.

On the district level, Wa West had a slightly lower proportion of its respondents, (62.3%) engaging in agriculture as compared to Yilo Krobo (77.85%). This was not surprising since the Northern Savannah often has to experience harsher climate variables during farming season as compared to Yilo Krobo located in the Tropic Forest Zone.

A slightly lower percentage, 61.5% of females was engaged in crop farming as compared to 77.8% males. When differentiated by districts women in Yilo Krobo represented a proportionally higher percentage (68.8%) in crop farming as compared to women in Wa West (54.7%). A probable explanation for this difference is because of the number of traditional hurdles such as inheritance norms, traditional gender roles as well as land tenure issues most women in Upper West face are likely to face when engaged in farming. This has been backed by several works such as (Antwi-Agyei et al., 2015).



4.5 Evaluation of gendered farmers’ perception of temperature changes

Table 4.1: Gendered perceptions of temperature changes

Perceptions	Yilo Krobo			Wa West			All		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Increased	56 (16.20)	80 (17.05)	136 (33.26)	102 (21.74)	90 (19.19)	192 (40.94)	156 (33.26)	176 (40.94)	332 (74.20)
Decreased	21 (4.48)	12 (2.56)	33 (7.03)	14 (2.95)	21 (4.48)	35 (7.46)	33 (7.04)	35 (7.46)	68 (14.50)
No change	17 (3.62)	9 (1.92)	26 (5.54)	5 (1.06)	3 (0.64)	8 (1.71)	26 (5.54)	8 (1.71)	34 (7.25)
Don't know	7 (1.49)	8 (1.71)	15 (3.198)	1 (0.21)	3 (0.64)	4 (0.85)	15 (3.20)	4 (0.85)	19 (4.05)
Total	121 (25.80)	109 (23.24)	230 (49.04)	122 (26.01)	117 (24.95)	239 (50.96)	230 (49.04)	239 (50.96)	469 (100)
P-values	$\chi^2 = 4.4714$ Pr = 0.215			$\chi^2 = 3.5469$ Pr = 0.315			$\chi^2 = 19.5153$ Pr = 0.000		

Source: Fieldwork, 2022.

Data collected (Table 4.1) showed that most respondents had an appreciable knowledge on the changes in temperatures. In this study, a total of 74.20 % of farmers across regions observed an increase in temperature. Of this percentage, a majority (40.96%) were females as compared to 33.26% of males who agreed that temperature was on the rise. The chi square test conducted shows that there is not a significant gendered difference in perception of temperature within each district. Though these differences were not significant, field interviews from this study indicate that, these differences may be explained by the traditional gender roles placed on both men and women, where men are tasked with engaging in intensive farming (Bessah et al., 2021) and women with the duty of primary caregiver. A female interviewee from Siiru stated the following:

“I sometimes know that there is an increase in temperature when the children complain about heat in the night. The heat makes the baby cry at night and I have to take care of him. The place has to

be kept very cool otherwise you will realize that the children develop shingles and heat rashes. And you have to buy things to treat it...” (23 year old female farmer, Siiru)

The above statement shows that women were more likely to perceive an increase in temperature due to their primary care giver role. This finding is in line with studies like Lawson et al. (2020) who investigated climate change and intersectional perceptions in the semi-arid regions of Ghana. In their study, they showed that women were more likely to observe changes in temperature due to cultural structures, which required them to carry out certain household responsibilities such as taking care of their children and visiting water bodies to supply water for the house. For instance, the above statement shows that, women are more likely to perceive changes in temperatures when their children contract skin diseases like heat rashes. Additionally, women are more likely to perceive an increase in temperature when water bodies dry up since in most rural households, women primarily provide water. However studies like Bessah et al. (2021) argue that male farmers are more likely to perceive temperature changes due to their involvement with intensive farming. Nonetheless, field interviews like the above statement showed that, despite the fact that rural women may not be intensive farmers; certain traditional gender roles conferred on them equipped them to perceive particular changes in temperature.



What may further account for a higher perception of temperature changes among women may be because women are often more vulnerable to the effects of climate change (Akinsemolu & Olukoya, 2020; Reggers, 2019). This is probably attributable to structural constraints like traditional inheritance systems, which gives women farmers' low access to productive resources such as acquiring or inheriting lands close to water bodies. They are therefore, compelled to go through the stress of watering their farms. This makes them more likely to observe changes in temperatures as well as experience its severe impact on their farms (Wrigley-Asante et al., 2019).

In addition, as the primary care giver in most rural households, rural women are more likely to divide their time between household chores, farming activities and engaging in climate SMART training programmes. They, therefore, often miss out on key strategies and interaction with extension officers that will aid in boosting crop yields on their farms. As a way to overcome this, some female farmers in their quest to utilize their human agency, rely on indigenous knowledge to detect changes in temperature so as to be able to predict the right planting time (Owusu & Yiridomoh, 2021). A study by Orlove and Roncoli (2010) in Uganda shows that this indigenous knowledge for rural female farmers are curated through observed historical patterns, such as an increase in night time temperatures, shifts in the directions of prevailing winds and the arrival of migratory birds. For some, indigenous knowledge was gained through an observation of weather conditions including the distant sightings of lightening and the state of the clouds. In this study for instance, women FGD in both districts agreed that they had to find a way to detect changes in temperature in order to find the right planting time.

This is echoed by a male respondent in Siiru youth FGD:

“When it comes to planting dates or time, is the women that decide when to sow and when not to sow, they are very good in monitoring climate conditions... They can predict the rain pattern and they mostly get it right” (Respondent 3, Siiru Youth FGD)

The statement above can also be illustrated within the framework of the structuration theory (Giddens, 1984) whereby despite the cultural structure constraints placed on women, some women through their capabilities, skillsets as well as indigenous knowledge are able to detect the or perceive changes in the temperature.

However, when differentiated by districts, the study showed that a slightly higher percentage of women in Wa West observed an increase in temperature as compared to women in Yilo Krobo. Such differences were expected since the Northern Savannah Zone is located in a much drier and hotter zone and were much more likely to experience hotter temperature changes as compared to respondents in the Tropical Forest Zone. Nonetheless, over half of female respondents in the Eastern region reported an increase in temperature. This denotes that, though temperature is on the rise in the Northern Savannah zone, areas located in the Forest Zone are equally experiencing changes in temperature as observed and reported by the data provided in this study (See, Section 4.2). Men across both regions equally reported an increase in the rise of temperature, with Wa West male respondents’ having a proportionally higher response as compared to men in Yilo Krobo. Despite these gendered differences within each district, the chi-square test conducted shows that there are no significant differences on the perception of temperature changes among gender across district. (Yilo Krobo: $\chi^2 = 4.4714$ Pr=0.215 and Wa West: $\chi^2 = 3.5469$ Pr= 0.315)

4.5.1 Farmers perception to changes in temperature according of district levels

Table 4.2: Farmers perception to temperature change according of district levels.

Variables	Increased	Decreased	No Change	Don't Know	Total
Yilo Krobo	156 (33.26)	33 (7.04)	26 (5.54)	15 (3.1)	230 (49.04)
Huhunya	54 (11.51)	16 (3.41)	5 (1.07)	7 (1.49)	82 (17.48)
Obawale	52 (11.09)	2 (0.43)	4 (0.85)	3 (0.64)	61 (13.01)
Akorley	50 (10.66)	15 (3.20)	17 (3.62)	5 (1.07)	87 (18.55)
Wa West	192 (40.94)	35 (7.46)	8 (1.71)	4 (0.85)	239 (50.96)
Siiru	74 (15.78)	2 (0.43)	2 (0.43)	0 (0)	78 (16.64)
Dabo	52 (11.09)	20 (4.26)	5 (1.06)	4 (0.85)	81 (17.27)
Siriyiri	66 (14.07)	13 (2.77)	1 (0.21)	0 (0)	80 (17.05)

Source: Fieldwork, 2022

Data as presented in **Table 4.2** show that across districts, farmers acknowledged an increase in temperatures. Statistically, a larger percentage of farmers in the Wa West agreed that temperatures had increased than those in the Tropic Forest Zone (33.26%). This was of no surprise to the researcher who had expected that more respondents in Wa West would perceive an increase in temperature as compared to respondents in the Yilo Krobo district due to the semi-arid weather conditions of the Wa West district. Nonetheless, the results showed that farmers across district believed that temperature has been on the rise. This tallies with data from metrological service as observed in **Figure 4.1** and **4.2**, which suggest that the highest mean monthly temperature between the years 1971-1996 was higher in Wa West (37.3 C), than in Yilo Krobo which was 34.7 C. This increased to 38.2 C between 1996-2021 in Wa West and 35.1 C in Yilo Krobo, an increase of 0.4C and 0.9C in Wa West. This shows that farmers from both districts have a high perception on temperature changes. This answers question one of this study, do local farmers' perception corresponds with climatic data? On the other hand, chi square test conducted in each district shows

that there is a significant spatial difference in the perception of temperature in each district. This presupposes that across the different communities in the two districts, certain key factors like land use, land topography and geographical location could account for the difference in perception among community farmers (Moradi et al., 2018).

4.5.2 Farmers perception of temperature changes according to age and levels of education

Table 4.3: Farmers' perception of temperature changes according to age and levels of education

Variables	Increased	Decreased	No Change	Don't Know	Total	Chi-square p value
	N (%)	N (%)	N (%)	N (%)	N (%)	
Age						
18 – 25	32 (82.1)	1 (2.6)	5 (12.8)	1 (2.6)	39 (100)	$\chi^2 = 23.7224$ Pr = 0.022
26 – 35	80 (72.1)	12 (10.8)	8 (7.2)	11 (9.9)	111 (100)	
36 – 45	116 (76.3)	23 (15.1)	9 (5.9)	4 (2.6)	152 (100)	
46 – 55	58 (68.2)	18 (21.2)	7 (8.2)	2 (2.4)	85 (100)	
56+	62 (75.6)	14 (17.1)	5 (6.1)	1 (1.2)	82 (100)	
All	348 (74.2)	68 (14.5)	34 (7.2)	19 (4.1)	469 (100)	
Level of education						
No formal education	133 (73.5)	34 (18.8)	9 (5)	5 (2.8)	181 (100)	$\chi^2 = 16.3699$ Pr = 0.358
Primary	55 (80.9)	6 (8.8)	5 (7.4)	2 (2.9)	68 (100)	
Junior Middle School (class 8-10)	108 (71.5)	22 (14.6)	15 (9.9)	6 (4)	151 (100)	
Senior High School /'A'level	36 (76.6)	3 (6.4)	3 (6.4)	5 (10.6)	47 (100)	
Vocational	6 (75)	1 (12.5)	1 (12.5)	0 (0)	8 (100)	
Tertiary	10 (71.4)	2 (14.3)	1 (7.1)	1 (7.1)	14 (100)	
Total	348 (74.2)	68 (14.5)	34 (7.2)	19 (4.1)	469 (100)	

Source: Fieldwork, 2022

Even more so, farmers' within certain demography have varied perceptions. Roco et al. (2016) suggests that certain demographic factors such as age and educational level could have an influence over farmers' perception on temperature changes. In this study, across all age groups, 74.2%

reported an increase in temperature. However, among the age groups, respondents within the ages of 18-25 years recorded the highest number of respondents who had seen an increase in temperature (82.1%), followed by 76.3% of farmers within the ages of 36-45 years. This implies that a higher percentage of young respondents perceived a change in climate. This is however, in glaring contrast with studies like Ochieng et al. (2016) where the older farmers are shown to be more likely to observe changes in the temperature due to longer farming experiences and subsequent extension services. Nonetheless, in-depth interviews conducted among older farmers in both regions highlighted that temperature within the last thirty years had been on the rise with significant increase in the early 2000s thereby being in harmony with findings of other literature like mentioned above. The sentiments of an older farmer from the Wa West district were captured in the statement below:

“When I was a child the temperature was not this hot. It was much easier to walk barefoot to the farms. But now the temperature has increased and the soil needs more water than before. During harmattan the leaves are much drier than before. [Points] you see the river over there. It was much larger than before. However, the dry temperature has over time dried it up. And it looks smaller you can’t even swim in it as I did when I was a kid” (75 year Old farmer Male farmer, Siiriyiru)

Similarly, a 60 year old farmer from the Yilo Krobo district talked about his perception of temperature change over the years:

“I told you, this place used to be a forest. There were several cash crops such as tobacco and sugarcane but after the 1983 bush fires happened somehow the temperatures increased so much

that some of the crops such as tomatoes were not thriving well. Now some of the rivers dry up much more quickly than before” (60 year old male farmer, Huhunya)

As noted in the above statements, some of the older farmers had observed a change in temperature intensity due to their familiarity and experiences of climate change manifestations (Filho et al., 2021). This is by the use of certain indicators such as river sizes drying up as well as certain crops not flourishing (Kibue et al., 2016).

4.6 Evaluation of farmers’ perception on rainfall

Table 4.4: Gendered perceptions of Farmers on rainfall distribution

Perceptions	Yilo Krobo			Wa West			All		
	Male	Female	All	Male	Female	All	Male	Female	All
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Increased	43 (9.17)	30 (6.40)	73 (15.57)	22 (4.69)	23 (4.90)	45 (9.59)	65 (15.57)	53 (9.59)	118 (25.16)
Decreased	58 (12.37)	51 (10.87)	109 (23.24)	98 (20.89)	90 (19.19)	188 (40.09)	156 (23.24)	141 (40.09)	297 (63.32)
No change	13 (2.77)	17 (3.62)	30 (6.40)	1 (0.21)	2 (0.43)	3 (0.64)	30 (6.40)	3 (0.64)	33 (7.04)
Don't know	7 (1.49)	11 (2.35)	18 (3.84)	1 (0.21)	2 (0.43)	3 (0.64)	18 (3.84)	3 (0.64)	21 (4.48)
Total	121 (25.80)	109 (23.24)	230 (49.04)	122 (26.01)	117 (24.95)	239 (50.96)	230 (49.04)	239 (50.96)	469 (100)
P-values	$\chi^2 = 3.5705$ Pr = 0.312			$\chi^2 = 0.9251$ Pr = 0.819			$\chi^2 = 60.3122$ Pr = 0.000		

Source: Fieldwork, 2022

Sampled farmers were further evaluated to gain insight on their perception on rainfall patterns and distribution. **Table 4.4** shows that respondents across both regions had observed a decrease in rainfall. Chi-square test conducted shows that there is not a significant gendered difference in the perception of rainfall distribution within and across districts. Despite the chi-square indicating that

there was no significant gendered differences, field interviews demonstrated that there were differences, interviews with key informants explained these differences,

“...the men engage in intensive farming, some of them have dug out wells which get filled when it rains. So when there is not enough rainfall it dries up and affects how they water their plants. Some of the women also experience water crises when the rainfall is unpredictable but I will say that the men are more likely to notice it when there is a change in rainfall” (Key Informant, Akorley).

The above statement shows that men are more likely to experience changes in rainfall patterns as a result of the intensive farming practices they engage in. As noted by Mahama et al. (2021), a higher percentage of male farmers are likely to notice a change in rainfall patterns as a result of their intensive farming practices. A change in rainfall patterns could have an impact on their income especially those engaged in cash crop production. Despite the differences, climate variability affects both men and women, as is confirmed in other studies conducted in Ghana (Denkyirah et al., 2017; Jamal et al., 2023)

On the basis of differentiated districts, a lower proportion of men in Yilo Krobo (47.9%) reported a decrease in rainfall as compared to men in Wa West. This was not a surprising outcome, since as established in earlier sections, the agro-ecological locations of the two districts under study meant showed that the Wa West experienced a singular raining season as compared to the Yilo Krobo, which had a double rainy season. It was therefore, expected that fewer respondents in Yilo Krobo would perceive a change in rainfall patterns and distributions as compared to Wa West. Like the male correspondents, fewer women in Yilo Krobo perceived a change in rainfall patterns and distributions as compared to Wa West. However, there are obvious differences in perceptions

among genders in each district. The P value between the perceptions of men and women across Yilo Krobo and Wa West show that the differences were statistically insignificant.

4.6.1 Farmers' perceptions of rainfall according to districts

Table 4.5: Farmers' perceptions of rainfall amounts according to districts

Variables	Increased	Decreased	No change	Don't Know	Total
Yilo Krobo	73 (15.57)	109 (23.24)	30 (6.40)	18 (7.8)	230 (100)
Huhunya	33 (7.04)	40 (8.53)	1 (0.21)	8 (9.8)	82 (100)
Obawale	4 (0.85)	39 (8.32)	15 (3.20)	3 (4.9)	61 (100)
Akorley	36 (7.68)	30 (6.40)	14 (2.99)	7 (8)	87 (100)
Wa West	45 (9.59)	188 (40.09)	3 (0.64)	3 (1.3)	239 (100)
Siiru	3 (0.64)	67 (14.29)	0 (0)	0 (0)	70 (100)
Dabo	24 (5.12)	51 (10.87)	3 (3)	3 (3.7)	81 (100)
Siriyiri	18 (0.21)	70 (14.93)	0 (0)	0 (0)	88 (100)

Source: Fieldwork, 2022

Table 4.5 illustrates the distribution of the respondents according to districts. A significantly higher percentage of respondents in Wa West (40.09%) believed that rainfall had decreased as compared to 23.24 % of respondents in Yilo Krobo. This was expected due to the dry conditions of the Wa West district. However, a reduction in rainfall and an increase in temperature are likely to exacerbate the already harsh weather conditions the region faces. This, in turn, is likely to have an impact on crop yield and, later on, household income. It also means that farmers are more likely have to invest more in adaptation strategies like irrigation or drought-resistant varieties in order to cope with these changes.

An interviewee in Siriyiri explained better:

'Well, to date it back, that will be around 2009, that is when I noticed a decrease in rainfall. It has been changing, and now it is worse. I just mentioned a few minutes ago that we are in June,

and rainfall is not in yet; I can't even remember the last time it rained; that will be two weeks now. It will come, and it will take a long time before it will rain again, and we have not started serious farming. Meanwhile, that is our main breadwinner; you were mentioning breadwinner; farming is our breadwinner, not even male or female. So, the weather has been changing, and it's continuing to change, it's not changing for the best; it's going backwards." (39 year old female farmer, Dabo)

On the other hand, a lower percentage of respondents in Yilo Krobo (23.24%) believed that rainfall had decreased as compared to the Wa West district. As indicated earlier, the Yilo Krobo district experiences a bimodal rainfall regime hence fewer respondent were more likely to perceive a decrease in rainfall. Focus group discussions in the Yilo Krobo district however suggest that these rainfalls have unpredictable high volumes of water, which could lead to flooding and possibly cause soil erosion. This suggests that farmers would have to invest in farming inputs like fertilizer to cope with the loss of soil nutrients or invest in other strategies to deal with the fallback that arises from flooding:

Nowadays, the rains are very unpredictable. We cannot even tell when it is going to rain. Before you realize it just starts to rain and it is very heavy. But it doesn't last for long. So it destroys the plants with short roots. After that there is severe heat, and you know some of these insects thrive in this weather. Before you realize they are eating the stems of the crops. Then there are the mango diseases, it is just not okay...' (28 year old male farmer, Obawale)

4.6.2 Farmers' perceptions of rainfall amounts according to age, and educational level

Table 4.6: Farmers' perceptions of rainfall amounts according to age and level of education

Variables	Increased	Decreased	No Change	Don't Know	Total	Chi square p value
	N (%)	N (%)	N (%)	N (%)	N (%)	
Age						
18 – 25	12 (30.8)	24 (61.5)	2 (5.1)	1 (2.6)	39 (100)	$\chi^2 = 22.2850$ Pr = 0.034
26 – 35	29 (34.1)	47 (55.3)	7 (8.2)	2 (2.4)	85 (100)	
36 – 45	24 (29.3)	52 (63.4)	6 (7.3)	0 (0)	82 (100)	
46 – 55	19 (17.1)	71 (64)	10 (9)	11 (9.9)	111 (100)	
56+	34 (22.4)	103 (67.8)	8 (5.3)	7 (4.6)	152 (100)	
All	118 (25.2)	297 (63.3)	33 (7)	21 (4.5)	469 (100)	
Level of education						
No formal education	42 (23.2)	126 (69.6)	8 (4.4)	5 (2.8)	181 (100)	$\chi^2 = 22.6365$ Pr = 0.092
Primary	13 (19.1)	46 (67.6)	6 (8.8)	3 (4.4)	68 (100)	
Junior Middle School (class 8-10)	47 (31.1)	82 (54.3)	15 (9.9)	7 (4.6)	151 (100)	
Senior High School (Class 11-12)/'A'level	7 (14.9)	32 (68.1)	3 (6.4)	5 (10.6)	47 (100)	
Vocational	3 (37.5)	4 (50)	1 (12.5)	0 (0)	8 (100)	
Tertiary	6 (42.9)	7 (50)	0 (0)	1 (7.1)	14 (100)	
Total	118 (25.2)	297 (63.3)	33 (7)	21 (4.5)	469 (100)	

Source: Fieldwork, 2022

Data from Table 4.6 shows that 67.8% of respondents over the ages of 56 years perceived a decrease in rainfall; this is followed by 64% of respondents between the ages of 26- 35 years. The chi square test conducted shows there is a significant difference in ages that perceived changes in rainfall amounts. This is noted in studies like Mamba et al. (2015) which showed that age could influence the level of rainfall perception. Field interviews in this study showed that older farmers were able to preserve changes in rainfall distributions with a span of 30 years:

“Oh it rains a lot, but you cannot compare it to when I was younger. I remember sometimes we could not cross the river when we closed from school because the banks will overflow. As for now, the banks still overflow but you cannot compare it to before. Now it [rains] is shorter too. There is just a difference and other farmers will tell you the same” (73 year old male farmer Obawale).

The above statement shows that older farmers are more likely to observe the change in the patterns of rainfall amounts over the years based on some of their experiences. As noted in Dhaka et al. (2010) and Mamba et al. (2015) older farmers are more likely to perceive changes in rainfall amounts as result of farming experience and indigenous knowledge on how to perceive climatic variables like rainfall amounts at the beginning of each planting.

When respondents were differentiated by the educational level, 63.3% of respondents believed that rainfall had decreased, followed by 25.2% who believed that it had increased whereas 7% did not know if it had increased or decreased. Of these figures, the highest percentage was from those without any formal education 69.6%. This is in contrast to what has been established by scholars such as Monroe et al. (2017) who suggests that people with a higher level of education have a higher perception of climatic variability. What may account for a contrast in this study is that often farming is considered to be for the poor and less educated, in instances where the highly educated engage in farming, it is often on the commercial level. This is further concurred by a study on young people’s perspectives on farming by (Sumberg et al. 2015), in which the authors asserted that some believed that farming was not compatible with people with higher educational achievements.

4.7 Gendered perception of rainfall patterns over the last 20-30 years

Table 4.7: Gendered Farmers perception of rainfall patterns over the last 20-30 years

Perceptions	Yilo Krobo			Wa West			All		
	Male	Female	All	Male	Female	All	Male	Female	All
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Delayed onset	23 (19)	24 (22)	47 (20.4)	77 (63.1)	62 (53)	139 (58.2)	47 (20.4)	139 (58.2)	186 (39.7)
Early onset	42 (34.7)	32 (29.4)	74 (32.2)	18 (14.8)	22 (18.8)	40 (16.7)	74 (32.2)	40 (16.7)	114 (24.3)
Extreme fluctuations	49 (40.5)	45 (41.3)	94 (40.9)	26 (21.3)	31 (26.5)	57 (23.8)	94 (40.9)	57 (23.8)	151 (32.2)
Don't know	7 (5.8)	8 (7.3)	15 (6.5)	1 (0.8)	2 (1.7)	3 (1.3)	15 (6.5)	3 (1.3)	18 (3.8)
Total	121 (100)	109 (100)	230 (100)	122 (100)	117 (100)	239 (100)	230 (100)	239 (100)	469 (100)
P-values	$\chi^2 = 0.9861$ Pr = 0.805			$\chi^2 = 2.6872$ Pr = 0.442			$\chi^2 = 72.5660$ Pr = 0.000		

Source: Fieldwork, 2022.

According to the 2021 GMet report, both the Northern Savannah Zone and the Tropical Forest zones have experienced a change in rainfall patterns. Hence, in line with research question one; there's been a need to understand if the respondents' perception of rainfall was in consonance with scientific data. The study, therefore, further assessed the gendered perception of respondents on rainfall patterns. Consequently, respondents were asked about how they perceived rainfall patterns in the last 20-30 years.

Data gathered and analyzed in this regard shows that, a higher proportion of respondents (39.7%) believed that there was now a delayed onset of rainfall over the last 20-30 years, whilst 32.2% perceived extreme fluctuations and 24.3% experienced an early onset of rainfall. These figures constitute male and female respondents across both regions. This suggests that respondents acknowledge changes and irregularities in rainfall patterns within the last 20-30 years. Of which,

58.2% of females perceived a delayed onset of rain fall compared to 20.4% of males. Additionally, 40.9% of men perceived extreme fluctuations compared to 23.8% of females. The chi-square test showed that there is a significant gendered difference in the perception of rainfall patterns across districts ($\chi^2 = 72.5660$ Pr=0.000). Field interviews indicate what could explain these differences:

“The rainfall pattern is not good. It doesn’t come at the time we want it so it makes our farming difficult for us. As a farmer, you cannot do without rainfall; it delays almost all our farming activities. It has made the farming season to look shorter this time around. You will start farming and by the time you realized, the farming season is over” (80 year old female farmer, Siiru)

A female respondent from Obawale similarly had the following to say:

“...in most cases, women are supposed to fetch water for domestic use. So, when there is abundant rainfall, we harvest water for use at home and we do not have to walk down there [riverside] to fetch water... We however cannot cause the rain to fall. So we have to walk long distances to fetch us water. In terms of farming, we wait to have sufficient rainfall before we start planting our crops. But sometimes, the rain stops unexpectedly” (33 year old female farmer, Obaawale).

Similar sentiments were shared by a respondent in a FGD in Huhunya:

‘...we suffer when there is scarcity of water. The man would go to farm and he is expecting that by the time he returns, there is water for him to bathe and food to eat. The man does not care how the woman would get the water... The women are affected more when there is scarcity of water. It is the responsibility of women to fetch water for use in the household’ (Respondent, Obawale female Focus Group Discussion).

The above statements reveal that traditional gender norms mandate women to provide water for their households whilst they equally supply water for their respective farms. The implication of this is shown in how they monitor and perceive rainfall patterns in order to carry out their duties. In the same vein studies like Mamba (2016) shows that women are likely to perceive changes in

rain fall patterns as a result of their active engagement in farming for their households. This is equally affirmed by (Adzawla et al., 2019).

Notwithstanding, among the districts, Yilo Krobo reported a slightly higher proportion of female respondents (22%) than males (19%), who claimed to have experienced a delayed onset of rainfall. On the other hand, females in Wa West had a slightly lower percentage (53%) reporting a delayed onset of rain as compared to the males (63.1%). Further analyses showed that 34.7% of male respondents believed that there was an early onset of rain as compared to 29.4% of women who believed the same, whereas in Wa West, 18.8% of female respondents believed that there was an early onset of rainfall as compared to 14.8%. Once again the differences between the two districts may be explained by their locations.

4.7.1 Farmers perceptions of rainfall patterns according to districts

Table 4.8: Farmers perception of rainfall distribution according to districts

Variables	Regular	Irregular	No Change	Extreme Fluctuations	Don't Know	Total
Yilo Krobo	91 (39.6)	49 (21.3)	68 (29.6)	4 (1.7)	18 (7.8)	230 (100)
Huhunya	50 (61)	12 (14.6)	11 (13.4)	1 (1.2)	8 (9.8)	82 (100)
Obawale	8 (13.1)	14 (23)	36 (59)	0 (0)	3 (4.9)	61 (100)
Akorley	33 (37.9)	23 (26.4)	21 (24.1)	3 (3.4)	7 (8)	87 (100)
Wa West	24 (10)	154 (64.4)	44 (18.4)	1 (0.4)	16 (6.7)	239 (100)
Siiru	1 (1.4)	53 (75.7)	15 (21.4)	0 (0)	1 (1.4)	70 (100)
Dabo	11 (13.6)	39 (48.1)	16 (19.8)	1 (1.2)	14 (17.3)	81 (100)
Siriyiri	12 (13.6)	62 (70.5)	13 (14.8)	0 (0)	1 (1.1)	88 (100)

Source: Fieldwork, 2022

Table 4.8 shows that, when spatially differentiated across districts, Yilo Krobo has a higher percentage of its respondents (39.6%), believing that rain fall has been regular as compared to 29.6% who indicated that there was no change and 21.3% believing that rainfall was irregular. This is different in comparison to Wa West which had a higher proportion of respondents (64.4%) believing that rainfall had been irregular. This was expected due to the locations of the two districts in two varying ecological zones. A majority of Ghana’s rural population largely depends on rain-fed agriculture (Klutse et al., 2021), therefore a dependency on rainfall is likely to make farmers in a drier harsher zone like the Wa West to be much more susceptible to changes in rainfall patterns than farmers in a forest zone with two rainy seasons.

4.7.2 Farmers perception of rainfall distribution

Table 4.9: Farmers’ Perception of rainfall according to age and educational level

Variables	Regular	Irregular	No Change	Extreme Fluctuations	Don't Know	Total	Chi square p value
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	
Age							
18 – 25	6 (15.4)	22 (56.4)	10 (25.6)	0 (0)	1 (2.6)	39 (100)	$\chi^2 = 29.8483$ Pr = 0.019
26 – 35	17 (15.3)	54 (48.6)	26 (23.4)	1 (0.9)	13 (11.7)	111 (100)	
36 – 45	35 (23)	63 (41.4)	40 (26.3)	3 (2)	11 (7.2)	152 (100)	
46 – 55	32 (37.6)	29 (34.1)	15 (17.6)	1 (1.2)	8 (9.4)	85 (100)	
56+	25 (30.5)	35 (42.7)	21 (25.6)	0 (0)	1 (1.2)	82 (100)	
All	115 (24.5)	203 (43.3)	112 (23.9)	5 (1.1)	34 (7.2)	469 (100)	
Level of education							
No formal education	39 (21.5)	93 (51.4)	34 (18.8)	2 (1.1)	13 (7.2)	181 (100)	Pearson chi2(20) = 46.8468 Pr = 0.001
Primary	12 (17.6)	34 (50)	16 (23.5)	1 (1.5)	5 (7.4)	68 (100)	

JHS	58 (38.4)	48 (31.8)	33 (21.9)	2 (1.3)	10 (6.6)	151 (100)
SHS/'A'level	2 (4.3)	20 (42.6)	20 (42.6)	0 (0)	5 (10.6)	47 (100)
Vocational	3 (37.5)	2 (25)	3 (37.5)	0 (0)	0 (0)	8 (100)
Tertiary	1 (7.1)	6 (42.9)	6 (42.9)	0 (0)	1 (7.1)	14 (100)
Total	115 (24.5)	203 (43.3)	112 (23.9)	5 (1.1)	34 (7.2)	469 (100)

Source: Fieldwork, 2022

Farmers were further asked about how they would describe the rainfall patterns of the farming season over the last 20 – 30 years. Across the various age groups, a proportionally high percentage of respondents believed that rainfall had been irregular, as compared to 24.5%, who believed that rainfall had been regular (**Table 4.9**). The chi square test conducted shows a significant difference in perception among the age groups. Of these various age groups, 56.4% of the respondents between the ages of 18-25 believed rainfall patterns had been irregular. This was followed by those within the ages of 26-35 which accounted for 48.6% of respondents who believed that rainfall patterns had been irregular. The respondents' perceptions of rainfall based on their educational level were examined. It was realized that across all educational levels, most respondents were of the view that rainfall distribution had become irregular. Of these, respondents with no formal education and primary education had a relatively higher percentage of perception that rainfall distribution had become irregular compared to those of differing educational level. The chi square test indicates that there is a significant difference to perception based on educational level. Though this is in contrast to perceptions studies undertaken in other parts of Africa (e.g Amani et al., 2022; Bagagnan et al., 2019; Muthelo et al., 2019), in which respondents with higher level of education were much more likely to perceive climatic variations as compared to those with lower or no form of higher education. A likely reason for the difference would be that in this study 38.6% of

respondents have no formal education. Hence, it is probable that more of such respondents would perceive climatic variations. On the other hand, farming is often attributed to the less educated. Therefore, fewer educated people are into farming (Asciutti et al., 2016; Okali & Sumberg, 2012; Yeboah et al., 2016).

4.8 Gendered perceptions of the Major causes of Climate Change

Table 4.10: Gendered Perception of causes of Climate Change

Perceptions	Yilo Krobo			Wa West			All		
	Male	Female	All	Male	Female	All	Male	Female	All
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Indiscriminate lumbering	63 (52.07)	42 (38.53)	105 (45.65)	109 (89.34)	110 (94.02)	219 (91.63)	172 (70.78)	152 (67.26)	324 (69.08)
Bush fire	46 (38.02)	41 (37.61)	87 (37.83)	76 (62.3)	72 (61.54)	148 (61.92)	122 (50.21)	113 (50)	235 (50.11)
Charcoal Burning	51 (42.15)	36 (33.03)	87 (37.83)	66 (54.1)	63 (53.85)	129 (53.97)	117 (48.15)	99 (43.81)	216 (46.06)
Use of agro-chemicals	38 (31.4)	27 (24.77)	65 (28.26)	49 (40.16)	39 (33.33)	88 (36.82)	87 (35.8)	66 (29.2)	153 (32.62)
Supernatural	72 (59.5)	77 (70.64)	149 (64.78)	71 (58.2)	67 (57.26)	138 (57.74)	143 (58.85)	144 (63.72)	287 (61.19)
Total valid Cases	121 (223.14)	109 (204.59)	230 (214.35)	122 (304.1)	117 (300)	239 (302.09)	243 (263.7)	226 (253.98)	469 (259.1)
P-values	$\chi^2 = 39.5526$ Pr = 0.072			$\chi^2 = 39.7796$ Pr = 0.016			$\chi^2 = 35.0074$ Pr = 0.204		

Source: Fieldwork, 2022.

A large percentage of respondents had earlier agreed that there was change in temperature, rainfall patterns as well as distributions. They were further probed to understand their perceptions on the major causes of climate change. In alignment with literature work (e.g Conway et al., 2019), multiple options of potential causes were presented to farmers to choose from. This included indiscriminate cutting down of trees, bush fire, charcoal burning, use of agro-chemicals, and supernatural. From these, respondents of both genders reported a number of reasons they considered as major causes of climate change.

Across regions, over 50% of respondents believed that a major cause of climate change was the indiscriminate cutting down of trees. A reason why this was a popular reason could be attributed to the government's constant campaign on afforestation and the fight against deforestation (Acheampong et al., 2019). This has in turn created more awareness on the effects of tree cutting. As was stated by one farmer from Dabo:

'The rivers are drying up. The trees no longer provide shade. They keep destroying it and now the sun has become very hot with no tree to cover the rivers' (38 year old male farmer, Dabo)

Though a large percentage of respondents believed the indiscriminate cutting down of trees is a driver of climate change, an equally large percentage 61.19% believed that the causes were supernatural. In Yilo Krobo, a higher percentage of women believed that a major cause of climate change was supernatural as compared to female respondents in Wa West district. Bessah et al. (2021) reinforces that women farmers are more likely to attribute the causes to climate change to an act of the supernatural. Though previous tables acknowledged that women across regions agreed that there was climate change, it is quite apparent that there are certain structural factors such as traditional gender roles as well as one's livelihood that influences a respondent's view on a cause of climate change. Consequently, the researcher realized that most of the causes were interconnected. This reflected the finding of a climate change perception study conducted in Tanzania by (Swai et al., 2012). In it, though the authors found out that most respondents believed that climate change was caused by the cutting down of trees. It was further understood that the other outlined causes were interlinked. In this study for instance, farmers would have to cut down more trees to access more farmlands or gain firewood to sell in order to diversify income as a result of poor crop yields. However in order to prepare the farmlands one would have to set bush fires, which also causes climate change. One might have to engage in the burning of charcoal to get extra

income. Yet one of the reasons for poor crop yields is climate change, however the means used to alleviate the effects equally causes and exaggerates the effects of climate change.

4.8.1 Farmers perception of the major causes of climate change according to districts

Table 4.11: Farmers Perception of the Major Causes of Climate Change according to Districts

Variables	Indiscriminate cutting down of trees	Bush fire	Charcoal burning	Use of agro-chemicals	Supernatural	Total valid cases
	N (% of cases)	N (%of cases)	N (%of cases)	N (%of cases)	N (%of cases)	N (%of cases)
Yilo Krobo	36 (43.9)	28 (34.15)	33 (40.24)	5 (6.1)	55 (67.07)	82 (191.46)
Huhunya	48 (78.69)	40 (65.57)	23 (37.7)	43 (70.49)	35 (57.38)	61 (309.84)
Obawale	21 (24.14)	19 (21.84)	31 (35.63)	17 (19.54)	59 (67.82)	87 (168.97)
Akorley	105 (45.65)	87 (37.83)	87 (37.83)	65 (28.26)	149 (64.78)	230 (214.35)
Wa West	63 (90)	51 (72.86)	42 (60)	30 (42.86)	41 (58.57)	70 (324.29)
Siiru	79 (97.53)	46 (56.79)	38 (46.91)	30 (37.04)	46 (56.79)	81 (295.06)
Dabo	77 (87.5)	51 (57.95)	49 (55.68)	28 (31.82)	51 (57.95)	88 (290.91)
Siriyiri	219 (91.63)	148 (61.92)	129 (53.97)	88 (36.82)	138 (57.74)	239 (302.09)

Source: Fieldwork, 2022

When spatially differentiated across regions, a proportionally high percentage of respondents in Wa West believed that climate change was caused by the indiscriminate cutting of trees as compared to a significantly low percentage of respondents in Yilo Krobo district. The researcher was however, not surprised with the findings as it corroborated other research works conducted in Ethiopia (Tesfahunegn et al., 2016) as well as other findings conducted in Bangladesh (Alam et al., 2017) and Nigeria (Ofuoku, 2011). The researcher, however, believes that a reason for the disparity in perception between the two districts maybe as a result of the Wa West district located in a Semi-arid and the Eastern Region in a forest zone. The location of the Upper West Region in the Northern Savannah Zone implies that owing to the harsher weather conditions, rivers would dry up faster if they are not in a shaded environment. It is therefore, easy to appreciate the effect

that deforestation has on the environment. Again, as mentioned in previous section, likelihood for this is the focus of climate change studies in the Wa West district. It is thus, likely that most respondents from the region can attribute the causes of climate change to scientific reasons such as deforestation. On the other hand, though in relation to the other causes of climate change a significantly higher percentage of respondents in Wa West as compared to Yilo Krobo believed that climate change could be caused bush fires, charcoal burning, and the use of agrochemicals. A larger percentage of respondents in Yilo Krobo believed that a major cause of climate change was supernatural.

4.8.2 Farmers perception of major causes of climate change

Table 4.12: Farmers perception of major causes of climate change according to age, and level of education.

Variables	Indiscriminate lumbering	Bush fire	Charcoal burning	Use of agro-chemicals	Supernatural	Total valid cases
	N (% of cases)	N (%of cases)	N (%of cases)	N (%of cases)	N (%of cases)	N (%of cases)
Age						
18 – 25	27 (69.23)	27 (69.23)	25 (64.1)	20 (51.28)	23 (58.97)	39 (312.82)
26 – 35	70 (63.06)	51 (45.95)	56 (50.45)	34 (30.63)	67 (60.36)	111 (250.45)
36 – 45	101 (66.45)	80 (52.63)	70 (46.05)	48 (31.58)	86 (56.58)	152 (253.29)
46 – 55	67 (78.82)	40 (47.06)	32 (37.65)	18 (21.18)	49 (57.65)	85 (242.35)
56+	59 (71.95)	37 (45.12)	33 (40.24)	33 (40.24)	62 (75.61)	82 (273.17)
All	324 (69.08)	235 (50.11)	216 (46.06)	153 (32.62)	287 (61.19)	469 (259.06)
Level of education						
No formal education	146 (80.66)	92 (50.83)	92 (50.83)	52 (28.73)	115 (63.54)	181 (274.59)
Primary	42 (61.76)	33 (48.53)	31 (45.59)	23 (33.82)	45 (66.18)	68 (255.88)
JHS	91 (60.26)	65 (43.05)	50 (33.11)	46 (30.46)	91 (60.26)	151 (227.15)
SHS						
/'A'level	33 (70.21)	31 (65.96)	31 (65.96)	23 (48.94)	26 (55.32)	47 (306.38)
Vocational	3 (37.5)	3 (37.5)	5 (62.5)	2 (25)	4 (50)	8 (212.5)
Tertiary	9 (64.29)	11 (78.57)	7 (50)	7 (50)	6 (42.86)	14 (285.71)
Total	324 (69.08)	235 (50.11)	216 (46.06)	153 (32.62)	287 (61.19)	469 (259.06)

Source: Fieldwork, 2022

In this study, 78.82% of respondents between the ages of 46-55 years believed that a major cause of climate change was the indiscriminate cutting down of trees. However, respondents between the ages of 18-25 years believed a major cause of climate change was bush fires. These results are in line with Ndamani and Watanabe (2016), which shows that majority of farmers attribute climate change variations to human related causes such as deforestation and deliberate bushfires. On the other hand, 75.1% of respondents above the age of 56 years believed that a supernatural cause was a major cause of climate change. This implies that farmers within an older age group believe that the occurrence of climate change is influenced by the supernatural. As noted in File et al. (2021) older farmer are more likely to blame climate change on the supernatural because they believed it as a punishment for breaking traditional taboos:

“I blame it on the bad practices of the youth. Nowadays there is a disregard on the things we used to hold sacred. Before there were some sacrifices and tokens we used to give to the gods before and after harvest but now I am the only who does it in my family. Even with some of the family they do not honour their family gods any more. Why won't the gods punish us with droughts and heavy rains? The youth think these are old fashioned but it is very necessary” (80 year old, female farmer, Huhunya)

When statistically differentiated on the educational level 80.66% of respondents without formal education believed that it was indiscriminate cutting down of trees that was the major cause of climate change, 78.57% of respondents on the tertiary level believed that it was bush fires as a major cause of climate change, this was followed by 66.18% of respondents of primary school level that believed that a supernatural force was a major cause of climate change.

4.9 Gendered effect of climate change on livelihood

Table 4.13: Gendered Effects of Temperature Change on Livelihoods

	Yilo Krobo			Wa West			All		
	Male	Female	All	Male	Female	All	Male	Female	All
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Declining crop yield	82 (67.8)	67 (61.5)	149 (64.8)	32 (26.2)	30 (25.6)	62 (25.9)	149 (64.8)	62 (25.9)	211 (45)
Declining income	4 (3.3)	3 (2.8)	7 (3)	9 (7.4)	3 (2.6)	12 (5)	7 (3)	12 (5)	19 (4.1)
Increased food insecurity	4 (3.3)	6 (5.5)	10 (4.3)	21 (17.2)	16 (13.7)	37 (15.5)	10 (4.3)	37 (15.5)	47 (10)
Increased water scarcity	8 (6.6)	15 (13.8)	23 (10)	2 (1.6)	9 (7.7)	11 (4.6)	23 (10)	11 (4.6)	34 (7.2)
Increased incidence of crop pests and diseases	8 (6.6)	5 (4.6)	13 (5.7)	16 (13.1)	14 (12)	30 (12.6)	13 (5.7)	30 (12.6)	43 (9.2)
worsening of human diseases / health challenges	5 (4.1)	7 (6.4)	12 (5.2)	34 (27.9)	33 (28.2)	67 (28)	12 (5.2)	67 (28)	79 (16.8)
Increased stress load	1 (0.8)	0 (0)	1 (0.4)	3 (2.5)	6 (5.1)	9 (3.8)	1 (0.4)	9 (3.8)	10 (2.1)
Increased work load	3 (2.5)	4 (3.7)	7 (3)	5 (4.1)	5 (4.3)	10 (4.2)	7 (3)	10 (4.2)	17 (3.6)
No effect	6 (5)	2 (1.8)	8 (3.5)	0 (0)	1 (0.9)	1 (0.4)	8 (3.5)	1 (0.4)	9 (1.9)
Total	121 (100)	109 (100)	230 (100)	122 (100)	117 (100)	239 (100)	230 (100)	239 (100)	469 (100)
P-values	$\chi^2 = 7.7469$ Pr = 0.459			$\chi^2 = 10.2429$ Pr = 0.248			$\chi^2 = 114.1890$ Pr = 0.000		

Source: Fieldwork, 2022.

It was imperative to understand how climate variability affected respondents' livelihood. A series of options were given to respondents to choose in order to determine the various effects that certain climatic factors such as increased temperatures and changes in rainfall patterns affected their livelihoods. In reference to temperature change, both men and women respondents across regions were given series of options to determine which ones were effects of temperature change on their

livelihood. Out of these options, 45% of both men and women respondents across the regions stated that an increase in temperature led to a decline in crop yield. This was expected as majority of respondents were crop farmers. This was followed by 16 % who believed that temperature change led to the emergence/worsening of human diseases/ health challenges and 10% believed that it led to an increase in food insecurity. However, 64.8% of male respondents across both regions reported that temperature change had led to a decrease in crop yield and this percentage is of a significantly higher proportion than women in both regions. This disparity was evident in each district where a higher proportion of male respondents believed that temperature change had led to a decline in crop yield. As reflected by respondent in Akorley:

‘Rising temperature cause poor yield of crops. When the temperature is too high and there is no rainfall, it destroys the emerging mango fruits. Too much rainfall also destroys the crops. So, we need condition in moderation. At the beginning of the mango season, we need rainfall for the trees to bear flowers. Then we need sunshine for a week or two and light rainfall for the fruits to form. If we do not get these conditions right, the mango is affected adversely and we cannot get good yield’ (49 year old Male Farmer, Akorley)

The above statement, represents the view that crops like mango needed the right amount of temperature to flourish, hence farmers need a moderate amount of temperature to have good yields. In-depth interviews with farmers further showed that traditional gender norms encouraged men to participate in intensive crop farming like mango plantation or act as caretakers on huge farms:

“My wife has a smaller farm...over there she grows okro and some other vegetables. Over here, my farm is bigger. It will be too be much for her if she has to take care of a farm like this. It will be too much work. I hardly see women with big farms any way... you can ask around, but it is not

that common. It might be because keeping a farm like that will be too expensive” (28 year old male farmer Obawale)

The above excerpt from an in-depth interview confirms findings from studies like Call and Sellers (2019) which expatiates on the gendered effects of temperature change on livelihood. In it the author argues how the propensity of male farmers to have crop yields affected by high temperature change is high as a result of their affinity to engage in intensive crop farming.

Consequently, a higher percentage of females across regions believed that an effect of temperature change was ‘emergence/worsening of human diseases/ health challenges. The chi-square test revealed that there is a significant gendered difference in the effect of temperature on livelihoods. This gendered difference was equally maintained in each region. As was established, field interviews had earlier indicated that traditional gender norms considered women to be the primary caregiver (See Chapter 2, 2.3; Chapter 4, 4.4). Women are therefore the first point of call should any household member fall sick or need health care. Studies like Alston (2014) further argue that women are susceptible to health conditions due to change in temperature, being prone to maternal anemia. Additionally earlier sections in this study showed that a higher percentage in women perceived an increase in temperature; it was therefore pre-empted that a higher percentage of women believed that an effect was the emergence of health conditions. This also corresponds with (Semenza, 2014) study, which revealed that high temperatures amplified health conditions like infectious diseases.

4.9.1 Perception on effects of Temperature changes on livelihoods according to district

Table 4.14: Effects of temperature changes on livelihoods according to districts

Variables	Declining crop yield	Declining income	Increased food insecurity	Increased water scarcity	Increased incidence of crop pests and diseases	Emergence/worsening of human diseases / health challenges	Increased stress load	Increased work load	No effect	
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	
Yilo Krobo	149 (64.8)	7 (3)	10 (4.3)	23 (10)	13 (5.7)	12 (5.2)	1 (0.4)	7 (3)	8 (3.5)	$\chi^2 = 71.7629$ Pr = 0.000
Huhunya	65 (79.3)	2 (2.4)	3 (3.7)	1 (1.2)	3 (3.7)	4 (4.9)	0 (0)	4 (4.9)	0 (0)	
Obawale	32 (52.5)	3 (4.9)	1 (1.6)	20 (32.8)	1 (1.6)	1 (1.6)	0 (0)	2 (3.3)	1 (1.6)	
Akorley	52 (59.8)	2 (2.3)	6 (6.9)	2 (2.3)	9 (10.3)	7 (8)	1 (1.1)	1 (1.1)	7 (8)	
Wa West	62 (25.9)	12 (5)	37 (15.5)	11 (4.6)	30 (12.6)	67 (28)	9 (3.8)	10 (4.2)	1 (0.4)	$\chi^2 = 60.4836$ Pr = 0.000
Siiru	19 (27.1)	8 (11.4)	5 (7.1)	5 (7.1)	3 (4.3)	26 (37.1)	4 (5.7)	0 (0)	0 (0)	
Dabo	18 (22.2)	1 (1.2)	13 (16)	3 (3.7)	22 (27.2)	14 (17.3)	1 (1.2)	9 (11.1)	0 (0)	
Siriyiri	25 (28.4)	3 (3.4)	19 (21.6)	3 (3.4)	5 (5.7)	27 (30.7)	4 (4.5)	1 (1.1)	1 (1.1)	

Source: Fieldwork

When differentiated spatially, 64.8 % of respondents in Yilo Krobo suggested that temperature change had led to a decline in crop yield, followed by 10% who believed that a change in temperature led to an increase in water scarcity. In Wa West, a significantly lower percentage of respondents as compared to Yilo Krobo reported that high temperature changes have resulted in a decline in crop yield. Comparatively, Wa West had a significantly higher percentage of respondents who reported that temperature changes led to emergence of health conditions. The chi test shows that there is a significant spatial difference in the effects of temperature change among communities in each district. This could be explained by either the land use, the location of the community or the type of livelihood undertaken by the people across the various communities in each district (Nhemachena et al. 2014). For instance in the Yilo Krobo, 79.3% of respondents in Huhunya stated that temperature change led to lower crop yield, followed by 59.8% of respondents in Akorley stating the same. These two communities largely depended on intensive farming. According to in-depth interviews and focus group discussions Huhunya has had a long history of cash crop farming like tobacco, cocoa, and cotton. A participant in the focus group discussion observed the following:

“...we used to grow tobacco and cotton here. They were just huge farms, many huge farms. Until the bush fire and droughts around the early ‘80s we used to be one of the main producers for those crops. We still have a few cocoa farms around. But I do not think it is as vibrant as it used to be before. After the fire everything went down” (Respondent, Huhunya male focus group discussion)

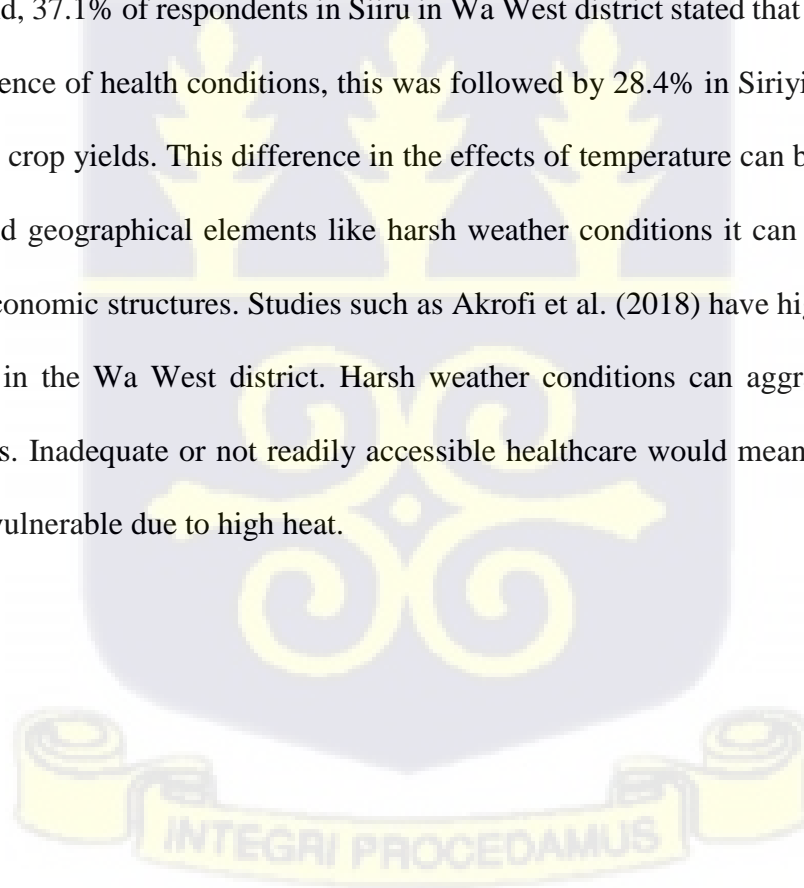
A key informant from Akorley also stated the following:

“...last year the mango harvest was bad [2020]. So we change the planting time...it did not work. There are two planting seasons for mango. So for some people they planted earlier but it failed,

some decided to wait till the later season. It did not work... it has always worked but now the temperature and the rainfall. You cannot even tell. Look around you. You see how the town is dull people now have to go out in search of money to cover up the lost. Many were waiting on the mango harvest...” (Key informant, Akorley)

There above statement represents Akorley as predominately a mango production community. The main source of the people’s livelihood is usually from the sale of mangoes. Although interspersed with the agricultural production of other crops like okro, tomatoes, and garden eggs. A poor mango yield has an adverse effect on the general well-being of the community.

On the other hand, 37.1% of respondents in Siiru in Wa West district stated that high temperatures led to the emergence of health conditions, this was followed by 28.4% in Siriyiri who mentioned that it led to low crop yields. This difference in the effects of temperature can be attributed to not only climatic and geographical elements like harsh weather conditions it can also be explained through socio-economic structures. Studies such as Akrofi et al. (2018) have highlighted the poor health facilities in the Wa West district. Harsh weather conditions can aggravate pre-existing health conditions. Inadequate or not readily accessible healthcare would mean that more people are likely to be vulnerable due to high heat.



4.9.2 Effects of temperature change on livelihoods according to farmers age and level of education

Table 4.15: Effects of temperature change on livelihoods according to farmers' age and educational level

Variables	Declining crop yield	Declining income	Increased food insecurity	Increased water scarcity	Increased incidence of crop pests and diseases	Emergence/worsening of diseases / health challenges	Increased stress load	Increased workload	No effect	
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	
Age										
18 – 25	14 (35.9)	2 (5.1)	7 (17.9)	4 (10.3)	5 (12.8)	5 (12.8)	0 (0)	1 (2.6)	1 (2.6)	$\chi^2 = 0.6813$ Pr = 0.533
26 – 35	49 (44.1)	5 (4.5)	12 (10.8)	7 (6.3)	11 (9.9)	17 (15.3)	5 (4.5)	3 (2.7)	2 (1.8)	
36 – 45	67 (44.1)	7 (4.6)	14 (9.2)	13 (8.6)	17 (11.2)	28 (18.4)	1 (0.7)	3 (2)	2 (1.3)	
46 – 55	36 (42.4)	3 (3.5)	5 (5.9)	5 (5.9)	6 (7.1)	17 (20)	4 (4.7)	7 (8.2)	2 (2.4)	
56+	45 (54.9)	2 (2.4)	9 (11)	5 (6.1)	4 (4.9)	12 (14.6)	0 (0)	3 (3.7)	2 (2.4)	
All	211 (45)	19 (4.1)	47 (10)	34 (7.2)	43 (9.2)	79 (16.8)	10 (2.1)	17 (3.6)	9 (1.9)	
Education										
No formal edu	66 (36.5)	4 (2.2)	28 (15.5)	5 (2.8)	14 (7.7)	46 (25.4)	4 (2.2)	10 (5.5)	4 (2.2)	$\chi^2 = 93.9677$ Pr = 0.000
Primary	32 (47.1)	4 (5.9)	7 (10.3)	3 (4.4)	8 (11.8)	12 (17.6)	1 (1.5)	1 (1.5)	0 (0)	
JHS	87 (57.6)	3 (2)	7 (4.6)	19 (12.6)	12 (7.9)	14 (9.3)	2 (1.3)	3 (2)	4 (2.6)	
SHS	14 (29.8)	7 (14.9)	4 (8.5)	5 (10.6)	6 (12.8)	5 (10.6)	2 (4.3)	3 (6.4)	1 (2.1)	
Vocational	2 (25)	0 (0)	0 (0)	1 (12.5)	3 (37.5)	1 (12.5)	1 (12.5)	0 (0)	0 (0)	
Tertiary	10 (71.4)	1 (7.1)	1 (7.1)	1 (7.1)	0 (0)	1 (7.1)	0 (0)	0 (0)	0 (0)	
Total	211 (45)	19 (4.1)	47 (10)	34 (7.2)	43 (9.2)	79 (16.8)	10 (2.1)	17 (3.6)	9 (1.9)	

Source: Fieldwork, 2022

Across the various age groups, 54.9% of respondents above the age of 56 stated that temperature changes have had an effect on the decline in crop yield. This might be because a lot of the older farmers have had more years to determine differences in crop harvest over a period in time (Weber, 2016). That is, a temporal observance of changes in temperature and its probable effect on crop yields within the last 20-30 year. However, perception on the other effects of temperature change was significantly lower in other age groups such as those within the ages of 46-55 years followed by 17.9 % of respondents between 18-25 years who believed that climate change had an effect on the increased risk of food insecurity. 18.4% of respondents within the ages of 35-46 believed that temperature has resulted in the emergence of human diseases. The following statement was stated by a respondent in an FGD:

“When the temperature is very high, we cannot work, if you try it you will get sick... High temperature causes sickness among the young people, when the temperature is high you can easily get dehydrated” (Respondent, Youth FGD Siiru)

When statistically differentiated by educational level, there were statistical differences such as 36.5% of respondents with no formal education believed that a change in temperature has triggered a decline in crop yield as compared to 71.4% of the respondents with tertiary education who also believed that there was a decline in crop yield attributable to temperature change.



4.10 Perception of the effects of rainfall on livelihoods

Table 4.16: Gendered perception of the effects of rainfall on livelihoods

	Yilo Krobo			Wa West			All		
	Male	Female	All	Male	Female	All	Male	Female	All
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Declining crop yield	62 (51.2)	60 (55)	122 (53)	80 (65.6)	74 (63.2)	154 (64.4)	122 (53)	154 (64.4)	276 (58.8)
Declining income	5 (4.1)	0 (0)	5 (2.2)	5 (4.1)	3 (2.6)	8 (3.3)	5 (2.2)	8 (3.3)	13 (2.8)
Increased food insecurity	8 (6.6)	5 (4.6)	13 (5.7)	25 (20.5)	29 (24.8)	54 (22.6)	13 (5.7)	54 (22.6)	67 (14.3)
Water scarcity	12 (9.9)	13 (11.9)	25 (10.9)	3 (2.5)	5 (4.3)	8 (3.3)	25 (10.9)	8 (3.3)	33 (7)
Increased incidence of crop pests	20 (16.5)	17 (15.6)	37 (16.1)	8 (6.6)	1 (0.9)	9 (3.8)	37 (16.1)	9 (3.8)	46 (9.8)
Emergence health challenges	4 (3.3)	4 (3.7)	8 (3.5)	0 (0)	3 (2.6)	3 (1.3)	8 (3.5)	3 (1.3)	11 (2.3)
Increased stress load	0 (0)	1 (0.9)	1 (0.4)	1 (0.8)	1 (0.9)	2 (0.8)	1 (0.4)	2 (0.8)	3 (0.6)
Increased workload	6 (5)	5 (4.6)	11 (4.8)	0 (0)	1 (0.9)	1 (0.4)	11 (4.8)	1 (0.4)	12 (2.6)
No effect	4 (3.3)	4 (3.7)	8 (3.5)	()	()	()	8 (3.5)	0 (0)	8 (1.7)
Total	121 (100)	109 (100)	230 (100)	122 (100)	117 (100)	239 (100)	230 (100)	239 (100)	469 (100)
P-values	$\chi^2 = 6.4908$ Pr = 0.592			$\chi^2 = 10.8747$ Pr = 0.144			$\chi^2 = 74.0870$ Pr = 0.000		

Source: Fieldwork, 2022

A higher percentage of men and women across both regions believed that changes in rainfall patterns and distribution have given rise to a decline in crop yield. Some argued that the unpredictability of the rains made it close to impossible to set up the planting season in time with

the rain. Others also complained that some plants did not like too much rain. However, some rains were more than required and ended up destroying the crops and thus causing poor harvest. This sentiment was reflected by one respondent:

“In the last mango season, our far did not bear fruits because of an unexpected heavy rainfall which destroyed the flowers. Meanwhile, the mango is our flagship crop that earns us much of the household’s income” (30 year old male farmer, Akoley)

This was further reiterated by a farmer in Huhunya:

‘Last year, rainfall in the major crop season was very low. It started early in February and March and we thought it would continue. So, most of us planted our crops. Unfortunately, by April, the rain stopped falling and our crops withered. Maize start counting days once it is sowed because, within three months it should mature so it needs rainfall on time. Unfortunately, when most maize farms reached the tasselling stage, there was drought, which cause abysmal yield last year. The lazy farmer who planted late rather was fortunate to get good rainfall getting to the end of the season and good yield. Then, in the minor season when nobody expected rainfall, it rained heavily, which destroyed our mango flowers’ (37 year old male farmer, Huhunya).

In some cases, the rains came with lots of wind which the stems of the plants were not strong in enough to withstand. About 14.3% of both men and women across both regions believed that changes in rain fall patterns led to an increase in food insecurity. This was followed by 9.8% of respondents who believed that the unpredictability of the rains led to increased incidence of crop pest and diseases.

When statistically differentiated by gender in each districts, 63.2% of women in women believed that a change in rainfall pattern led to a decline in crop yield as compared to 55% of women in Yilo Krobo. This was not unexpected, as established earlier the Northern Savannah zone experiences lesser rain fall than the forest zone and this subsequently accelerated lower crop yield.

On food insecurity, 24.8% of females in Wa West believed that changes in rainfall led to an increase risk of food insecurity as compared to 20.5% males in Wa West.

A further analysis of the table shows that slightly lower percentage of women in Yilo Krobo believed that climate change had led to an increase in pests and diseases. This observation is in contrast with the significantly higher percentage of men in Wa West who believed that rain fall patterns had led to an increase in pest and diseases. This could be explained by the land disparity uses among men and women in the Wa West district; for example most women did not have access to large sections of land to make concurrent complains. Nonetheless, one would notice a higher percentage of women believed that a change in rainfall patterns had resulted in an increase in food insecurity. This is attributable to the fact that most women storing and cooking foods in in most households.

4.10.1 Main effects of rainfall on livelihoods according to districts

Table 4.17: Effects of Rainfall on Livelihoods according to Districts

Variables	Declining crop yield	Declining income	Increased food insecurity	Increased water scarcity	Increased incidence of crop pests and diseases	Emergence / worsened human diseases / health challenges	Increased stress load	Increased work load	No effect	Chi square p value
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Yilo Krobo	122 (53)	5 (2.2)	13 (5.7)	25 (10.9)	37 (16.1)	8 (3.5)	1 (0.4)	11 (4.8)	8 (3.5)	$\chi^2 = 94.329$ 9 Pr = 0.000
Huhunya	56 (68.3)	2 (2.4)	7 (8.5)	4 (4.9)	4 (4.9)	5 (6.1)	1 (1.2)	3 (3.7)	0 (0)	
Obawale	31 (50.8)	1 (1.6)	0 (0)	21 (34.4)	6 (9.8)	1 (1.6)	0 (0)	0 (0)	1 (1.6)	
Akorley	35 (40.2)	2 (2.3)	6 (6.9)	0 (0)	27 (31)	2 (2.3)	0 (0)	8 (9.2)	7 (8)	
Wa West	154 (64.4)	8 (3.3)	54 (22.6)	8 (3.3)	9 (3.8)	3 (1.3)	2 (0.8)	1 (0.4)	-	$\chi^2 = 24.867$ 6 Pr = 0.036
Siiru	51 (72.9)	4 (5.7)	11 (15.7)	0 (0)	3 (4.3)	1 (1.4)	0 (0)	0 (0)	-	
Dabo	45 (55.6)	1 (1.2)	21 (25.9)	7 (8.6)	4 (4.9)	2 (2.5)	0 (0)	1 (1.2)	-	
Siriyiri	58 (65.9)	3 (3.4)	22 (25)	1 (1.1)	2 (2.3)	0 (0)	2 (2.3)	0 (0)	-	

Source: Fieldwork, 2022

When differentiated spatially, 64.4% of respondents in Wa West believed that a change in rainfall patterns had accelerated a decrease in crop yields. Interestingly, a higher percentage of respondents in both regions believed a change in rainfall had caused an increase in food insecurity as compared to a decline in income. However, a significantly higher percentage of respondents in Yilo Krobo believed a change in rainfall patterns led to an increase in incidence of crop pests and diseases. This is possibly due to Yilo Krobo farming crops such as mangoes which depend more on accurate rainfall patterns as compared with those in Wa West. Consequently, a high incidence of crop pests and diseases could lead to a vicious cycle among farmers since farmers would have to spend a copious amount of money on pesticides to curtail the phenomenon. An inadequate supervision by extension officers might imply the over usage of these chemicals hence reduce the fertility of the soil. This could result in a decline in crop yield and potentially an increase in food insecurity. The FGD in Akorley had the following complaints to make about the extension officers:

“We do not even get Agriculture extension officer from the Ministry of Food and Agriculture to educate us on modern agricultural practices... If we have a problem and we invite them, they come to look at it and if they have any advice, they give. But they do not visit us periodically. How many of us poor farmers can muster the courage to go to the Extension Officers to come and have a look at pests and diseases on our farms?” (Respondent, Akorley Youth FGD)

When differentiated spatially, 64.4% of respondents in Wa West believe that a change in rainfall patterns had facilitated a decrease in crop yields. Interestingly, a higher percentage of respondents in both regions believed a change in rainfall led to an increase in food insecurity as compared to a decline in income. However, a significantly higher percentage of respondents in Yilo Krobo believed a change in rainfall patterns was a driver of an increase in the incidence of crop pests and diseases. This was expressed by a farmer:

“... We force the mango trees to bear flowers in a month that we do not expect heavy rainfall. Getting to the maturing stage of the mango when it starts to have sugar too, we do not want rainfall because that will increase the spread of the bacteria black spot (BBS) disease. The BBS thrives in cold and wet weather. So, we factor all these things before we force the mango trees. Unfortunately, the weather is becoming unpredictable. That is our major challenge” (33 year old farmer, Akorley).

As stated by the farmer, crops such as mango are at risk of being infected by diseases, if the right amount of rain does not fall at the right time. This statement may account for why a high percentage of respondents in Yilo Krobo perceived that a change in rainfall leads to an increase on crop pests and diseases as compared to respondents from Wa West.

4.10.2 Perception of the effects of rainfall on livelihoods

Table 4.18: Main effects of rainfall on livelihood

Variables	Declining crop yield	Declining income	Increased food insecurity	Increased water scarcity	Increased incidence of crop pests and diseases	worsened human diseases / health challenges	Bigger stress load	Bigger work load	No effect	Chi square p value
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Age										
18 – 25	23 (59)	3 (7.7)	4 (10.3)	1 (2.6)	5 (12.8)	2 (5.1)	0 (0)	0 (0)	1 (2.6)	$\chi^2 = 40.4639$ Pr = 0.145
26 – 35	64 (57.7)	3 (2.7)	20 (18)	4 (3.6)	13 (11.7)	2 (1.8)	0 (0)	1 (0.9)	4 (3.6)	
36 – 45	86 (56.6)	5 (3.3)	18 (11.8)	14 (9.2)	14 (9.2)	6 (3.9)	0 (0)	8 (5.3)	1 (0.7)	
46 – 55	53 (62.4)	0 (0)	11 (12.9)	10 (11.8)	6 (7.1)	1 (1.2)	2 (2.4)	1 (1.2)	1 (1.2)	
56+	50 (61)	2 (2.4)	14 (17.1)	4 (4.9)	8 (9.8)	0 (0)	1 (1.2)	2 (2.4)	1 (1.2)	
All	276 (58.8)	13 (2.8)	67 (14.3)	33 (7)	46 (9.8)	11 (2.3)	3 (0.6)	12 (2.6)	8 (1.7)	
Education										
No for. Edu	112 (61.9)	3 (1.7)	40 (22.1)	6 (3.3)	9 (5)	3 (1.7)	3 (1.7)	4 (2.2)	1 (0.6)	$\chi^2 = 75.5966$ Pr = 0.001
Primary	44 (64.7)	4 (5.9)	6 (8.8)	2 (2.9)	7 (10.3)	1 (1.5)	0 (0)	4 (5.9)	0 (0)	
JHS	81 (53.6)	5 (3.3)	11 (7.3)	16 (10.6)	24 (15.9)	7 (4.6)	0 (0)	2 (1.3)	5 (3.3)	
SHS	28 (59.6)	0 (0)	7 (14.9)	6 (12.8)	4 (8.5)	0 (0)	0 (0)	0 (0)	2 (4.3)	
Vocational	4 (50)	1 (12.5)	1 (12.5)	0 (0)	1 (12.5)	0 (0)	0 (0)	1(12.5)	0 (0)	
Tertiary	7 (50)	0 (0)	2 (14.3)	3 (21.4)	1 (7.1)	0 (0)	0 (0)	1 (7.1)	0 (0)	
Total	276 (58.8)	13 (2.8)	67 (14.3)	33 (7)	46 (9.8)	11 (2.3)	3 (0.6)	12(2.6)	8 (1.7)	

Source: Fieldwork 2022

Respondents within the ages of 46-55 years believed that crop yields had declined due to changes in rainfall patterns, whereas 18% of those between the ages of 26-35 years believed that it had expedited food insecurity. When differentiated by their educational level, it appears that respondents with a primary level had a higher percentage of respondents believing that a change in rainfall led to a decline in crop yield. This was followed by those with no formal education. A higher percentage of those with no formal education believed that it leads to water scarcity. When differentiated by gender, 59.3% of females believed that a change in rainfall patterns led to an increase in decline crop yield whilst a slightly higher percentage believed that it led to an increase in crop yield.

4.11 Conclusion

Findings from this chapter in answering research question one demonstrated that, rural farmers in both districts have a high level of climate change perception which is equivalent to climatic data collected from the Ghana metrological agency (See Figure 4.1 and 4.2). This reflects a growing acknowledgement among farmers about the presence of climate change. The study also found that farmers in both districts perceived climate change as a threat to their livelihoods, with many reporting the negative effects of climate change on their farming activities. This was indicated by a majority of respondents who had witnessed forms of climate change variations such as an increase in temperature, decreased amount of rainfall as well as manifestations of extreme fluctuations of rainfall distributions. Percentage data conducted further showed that there is a gendered difference in local farmers' perception of temperature changes, rainfall patterns and distribution. In-depth interviews and FGDs illuminated that, these gendered differences were as a result of cultural structures like traditional gender norms which made women the primary care givers and encouraged men to practice intensive farming. This further reaffirmed a tenet of

Giddens (1984) structuration theory, which asserts that certain structures in society influences the actions of social actors. In the context of this study, men and women respondents were required by cultural structures to engage in particular actions, which in turn influenced their perception on climate variations. Additionally, the chapter showed that there was significant spatial difference local farmers' perception of climate change. This difference could be attributed to the different agro-ecological locations of the study areas. The study highlighted the role that gendered and spatial differences of farmers' perception of climate change impact their adoption of adaptation strategies.

Most importantly, the findings of this chapter brings to the forefront, the need for a tailored and context specific climate change solutions by policy makers. By understanding the various gendered and spatial dynamics of climate change perceptions, the researcher believes that it would be of great initiative for famers from various social groups to be actively involved in climate change policies. In addition, findings from this encourage a revamp of the climate change perception of policymakers, researchers and major stakeholders in Ghana. It also creates room to understand that climate change equally occurs in regions like the Forest zone and equally has negative impacts on their farmers' livelihoods.

In conclusion, findings from this study make available valuable awareness in the climate change perceptions of rural farmers in the Yilo Krobo and Wa West district. It also stresses the need to involve farmers from various social groups in the formulation of policies this is to ensure not only an effective but a holistic policy implementation.

CHAPTER FIVE

SPATIAL AND GENDERED DYNAMICS OF IN-SITU CLIMATE ADAPTATION STRATEGIES

5.0 Introduction

Studies on climate change adaptation strategies in Ghana often consider the spatial and gender differentials within regions in the same agro-ecological zone. These are often located in the Northern Savannah zone because of its harsh weather conditions. The preceding chapter showed that farmers in both regions have a level of awareness and concern about climate change. It also revealed that there is growing recognition of the impact of climate change on their livelihoods. This has created a need to adopt certain adaptation strategies to cope with climate change. However, literature and further investigation in this study show that rural farmers face some limitations in adopting these strategies. In the light of this and in accordance to research question two, this chapter will explore the spatial and gendered differentials of adaptation strategies across regions located in the Northern Savannah zone and the Tropical Forest Zone. The chapter relies on insight from the structuration theory to examine the relationships between human agency and economic structures. It further draws on the entitlement framework to explain spatial and gender access to resources.

5.1 Adoption of improved irrigation

Irrigation is considered as one of the go-to adaptation strategies for unpredictable climate conditions (Bawakyillenuo et al., 2016). According to Asante et al. (2021), the adoption of a strategy is often dependent on the farmers' perception of climate change. Irrigation as a strategy is

often adopted to counter the effects of an increment in temperature and the unpredictability of rainfall. As a result, farmers in places like the Northern Savannah Zone are expected to adopt the strategy due to the harsh weather conditions in order to cope with poor crop yields that could otherwise affect their livelihoods (Yaro et al., 2016).

However, contrary to what contemporary literature such as Worqlul et al. (2019) and Laube et al. (2012) suggest, a large percentage of respondents in this study did not adopt improved irrigation.

Table 5.1a: Adoption of improved irrigation

	Male		Female		All	
	Adopted	Not adopted	Adopted	Not adopted	Adopted	Not adopted
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
All	61 (25.1)	182 (74.9)	45 (19.9)	181 (80.1)	106 (22.6)	363 (77.4)
Yilo Krobo	29 (24)	92 (76)	17 (15.6)	92 (84.4)	46 (20)	184 (80)
Huhunya	11 (25)	33 (75)	7 (18.4)	31 (81.6)	18 (22)	64 (78)
Obawale	3 (9.7)	28 (90.3)	0 (0)	30 (100)	3 (4.9)	58 (95.1)
Akorley	15 (32.6)	31 (67.4)	10 (24.4)	31 (75.6)	25 (28.7)	62 (71.3)
Wa West	32 (26.2)	90 (73.8)	28 (23.9)	89 (76.1)	60 (25.1)	179 (74.9)
Siiru	19 (55.9)	15 (44.1)	20 (55.6)	16 (44.4)	39 (55.7)	31 (44.3)
Dabo	9 (22)	32 (78)	7 (17.5)	33 (82.5)	16 (19.8)	65 (80.2)
Siriyiri	4 (8.5)	43 (91.5)	1 (2.4)	40 (97.6)	5 (5.7)	83 (94.3)
P-values	$\chi^2 = 29.5328$ Pr = 0.000		$\chi^2 = 44.7037$ Pr = 0.000		$\chi^2 = 71.4480$ Pr = 0.000	

Source: Fieldwork, 2022

Table 5.1a shows that across regions less than 50% of respondents, that is 22.6% adopted irrigation. Even so, the adoption of the strategy varied among respondents in the districts under study and among genders. For instance, within the Yilo Krobo, 24% of the male respondents adopted irrigation as compared to 26.2% of male respondents in Wa West. The percentage of women (15.6%) who adopted irrigation in the Yilo Krobo district was significantly lower than

women in the Wa West (23.9%).¹ Such differences between the districts were not unexpected since the Northern Savannah Zone experiences one rainy season as compared to the Tropical forest zone, which experiences two major rainy seasons. On this premise, the researcher assumes that the single rainy season in the Wa West district indicates that a larger percentage of respondents would engage in irrigation as compared to those in Yilo Krobo. Despite the obvious reason for the disparity, focus group discussions revealed another cause for the comparatively higher rate of adoption in Wa West district. Some respondents in the Yilo Krobo district complained about the government focusing on farmers in the Northern Savannah Zone and refusing to cater for the needs of those in the Forest zone. This was often due to the perception that farmers in the Upper West were more susceptible to climate variabilities:

“Some farmers are able to pump water to irrigate their field but the government has not provided any irrigation system in this region. Most of the dams and irrigation system are constructed in Northern Ghana. They think that place is more vulnerable to climate change but farmers in the Yilo Krobo district are also being devastated by the effects of climate change” (Agriculture Extension Officer, Yilo Krobo).

Despite experiencing two rainfall seasons and being located in the forest zone, the region has over the years experienced erratic rainfall patterns and an increment in temperature. This meant that farmers could no longer solely rely on the rains for their farms. However, inadequate help from government discouraged most respondents in Yilo Krobo from partaking in irrigation.

A farmer also shared the following sentiment:

¹ Kindly note that significantly used here is based on the percentages not chisquare test

“No, we do not have irrigation system here... the government has not and will not provide that facility to us” (Key Informant, Obawale).

When probed why he believed that the government would not aid in providing irrigation, the farmer had this to say:

“Oh, the government has even stopped subsidizing common fertilizer to farmers. How much more constructing a dam and an irrigation system for us? The only thing we are benefiting from now is pipe borne water. That has reduced the work load of women. They no longer walk long distances during the harmattan to fetch polluted water for domestic use” (Key Informant, Obawale).

In comparison, in the Wa West district, most respondents had a certain level of accessibility to dams or irrigation facilities. Some farmers also cultivated some crops around the dam in order to gain easier access to the dams:

“Yes. We practice irrigation in Siiru. Those who want to farm at the dam, they have plots or land there where they cultivate their crops” (Respondent, Siiru youth FGD).

Yet, there were a number of respondents who did not adopt the strategy because of the poor state of the dam. This was explained by a key informant in Siriyiri:

“There is a dam but it has broken. The level of damage is too great that is why it cannot hold water for too long such that people can make gardens around it. There is always water during the rainy season but it all disappears during the dry season” (Key informant, Siriyiri).

Others also claimed that the soil surrounding the dam did not promote good crop yields as quoted by a respondent in Dabo focus group discussion below:

“Yes people farm around the dam, during dry season people cultivates vegetables and sell. There are many gardens in the dam area, of late farmers have been complaining about the soil in that area.it seem the soil is no longer good in that area, there are complains of pest attacks on vegetable such as tomatoes and lettuce” (Dabo Female Focus Group Discussion).

Regarding gender, when statistically differentiated within each district, **Table 5.1a**, it was shown that a slightly lower percentage of female respondents adopted the strategy as compared to the male respondents. This was equally the same in Wa West. This was however, expected, since literature works like Bessah et al. (2021) highlight the gender disparity in climate change adaptation. Societal structures such as economic, gender roles and norms as well as patriarchal norms on land inheritance and ownership serve as structures that constraint the adoption of irrigation by women (Wrigley-Asante et al., 2019; Glazebrook et al., 2020; Partey et al., 2020). This conflates with Giddens (1984) structuration theory, which posits that certain structures could impede the societal growth of social actors. For example, in recent years, despite a larger section of women being engaged in farming (Sutherland et al., 2023), most are not owners of the land and have to depend on their husbands' lands. As pointed out in the entitlement framework (Sen, 1981), household or individual access to endowments such as rights and ownerships to land can improve the chances of adopting a strategy. Teye and Owusu (2015) further argue that different people in society will have various levels of adaptive capacities due to the differences in endowments. Hence, in the context of this study, since few women had rights and ownership to land, many had lower level of an adaptive capacity and were discouraged from engaging in irrigation practices such as dug out wells. Though this is not a peculiar issue to only women (Teye & Owusu, 2015), most women are more likely to have this experience because of traditional land tenure ownership structures. . As explained by an agricultural extension officer in the Eastern Region:

“...if you go to the Krobo area, women do not own land. So, if women do not own land, they will find it difficult to get land to farm. Sometimes, women get marginal land that is far from water bodies, so when they experience unfavorable weather conditions it worsens their plight...”

(Agriculture Extension Officer, Mofa)

During field interviews in Siriyiri, a key informant is quoted explaining the progress of women’s access to land:

“Mmm when we were young, the access of women to resources was not all that good or easy. They do not have access to some of these resources you mentioned but with civilization thing are getting better now. In my household, my mother has her own land now but when we were young, she did everything on my father’s farm. We now have so many women having access to these resources they didn’t have 10 years ago. When it comes to the issue of land, it is still difficult for women to have access, unless the woman is rich and buys her own land or the husband dies and she take charge of her husband land” (Key informant, Siriyiri)

The above statement acknowledges the constraints most rural women face in the ownership and acquisition of land, however as pointed out by the key informant some women through their financial independence or widowhood status are able to overcome some of the hurdles. Building on the structuration theory (Giddens, 1984) this finding acknowledges how the human agency can overcome social structures. For instance, in the context of this study women through their human agency were able to acquire some rights to access lands through marriage and in certain instances through financial independence. The implementation of the human agency in most cases stemmed from the utilization of intangible assets of women such as skills and knowledge. This as indicated by the entitlement framework is known as endowments (Sen, 1981). It is therefore, of importance

to note that some social actors in society, in this context referring to women, may lack appropriate endowments such as no land ownership as a result of structural constraints in society. Yet, some through their agency has overcome these constraints (Giddens, 1984). For example, some women utilized their skills in petty trading until they were able to gather enough funds to acquire or rent a piece of land. As it was pointed out during an in-depth interview, some women could own land if they had money:

“Those women whose husbands have vast land easily get land to farm. But generally, it is not difficult to get land for women to farm. If only they have the money. Things have changed” (35 year old female farmer, Dabo)

Furthermore, some field interviews also revealed that though women may have more accessibility to land in recent times, some of them were not interested in the family land because of marriage. Some like a 40 year old farmer in Huhunya maintained the following:

“Nobody would prevent a woman from having access to the family land. However, as the land is insufficient for all of us to farm, it is set aside as a resource to for maintaining the family house. So, those who are cultivating that land has the responsibility of making sure that the family house is renovated periodically and most of the women in the family are not interested in that. Because, some of them are married” (40 year old Male Farmer, Huhunya)

As stated in the above statement, some women may not be interested in owning a family land due to their interest in marriage. Hence, there is no need to adopt an intensive strategy like irrigation when they can use a portion of their husband’s land.

Reasons for not adopting strategy

Table 5.1b: Reasons for not adopting irrigation strategy

	Yilo Krobo			Wa West			All		
	Male	Female	All	Male	Female	All	Male	Female	All
	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)
Lack of finance	37 (48.7)	40 (52.63)	77 (50.66)	18 (20.93)	21 (23.86)	39 (22.41)	55 (33.95)	61 (37.2)	116 (35.58)
Lack of information	0 (0)	5 (6.58)	5 (3.29)	5 (5.81)	4 (4.55)	9 (5.17)	5 (3.09)	9 (5.49)	14 (4.29)
It would not help	37 (48.7)	35 (46.05)	72 (47.37)	21 (24.42)	36 (40.91)	57 (32.76)	58 (35.8)	71 (43.29)	129 (39.57)
The land is not owned by us	0 (0)	1 (1.32)	1 (0.66)	1 (1.16)	0 (0)	1 (0.57)	1 (0.62)	1 (0.61)	2 (0.61)
Other reason	16 (21.1)	6 (7.89)	22 (14.47)	59 (68.6)	48 (54.55)	107 (61.49)	75 (46.3)	54 (32.93)	129 (39.57)
Total valid cases	76 (118.4)	76 (114.47)	152 (116.45)	86 (120.93)	88 (123.86)	174 (122.41)	162 (119.75)	164 (119.51)	326 (119.63)

Source: Fieldwork, 2022

The above table **Table 5.1b** shows the reason why a large percentage of farmers in both districts did not adopt irrigation. Across regions, 39.57% of the respondents stated that the strategy would not work, followed by 35.58% also indicating that a lack of finance, and 4.29% stating that they were not owners of the land. When spatially differentiated, a slightly higher percentage of respondents in Yilo Krobo stated the lack of finance as a reason for not adopting the strategy. This was followed by 47.37% who stated that the strategy would not work. A 23 year old farmer's wife from a community in Yilo Krobo reiterated this:

“Yes, my husband has a dugout well in his farm so when there is no rain; we pump water to irrigate the vegetable farm. However, it is not as effective as rainfall. We do not have enough money to buy fuel to power the pumping machine every other day to irrigate the farm. This is crucial because when the okra is more than two weeks after it germinated, it is practically difficult to water them by hand” (23 year old female Farmer, Huhunya).

In Teye and Owusu (2015), it was realized that farmers with adequate financial resources could own land or buy expensive irrigation inputs. Their work further pointed out that farmers' inadequate access to financial resources, may be as a result of entitlement failure emanating from poor government policies and economic structures which was a barrier to the adaptation of irrigation. In this study, most farmers argued that lack of finances alongside inadequate help from the government disempowered some farmers particularly, in the Yilo Krobo district from adopting irrigation. Some farmers argued that the capital-intensive nature of irrigation discouraged them from adopting the strategy prompting them to diversify as a 40 year old from Obawale stated:

“Crop farming in this village is purely rain fed... Irrigation is capital intensive and farming is not my only source of livelihood so I do not want to invest in that” (40 year old male Farmer, Obawale)

When we consider gender, a higher percentage of women in both districts stated a ‘lack of finance’ as a reason why the strategy was not adopted. This was not unexpected since most farm inputs were expensive and were almost unaffordable to women. Some women equally did not have access to financial institutions. Those who did, often reinvested the money in the up keep of the home, some also engaged in petty trading for a readily available profit:

“Farm inputs are very expensive. The pump is almost 3000 cedis. Even the men can't afford it. My husband was able to buy his because he worked as a labourer on a mango farm last year...I also made some money but I used it to buy some goods to sell” (31year old female Farmer from Akorley)

*Effectiveness of irrigation strategy***Table 5.1c: did strategy (improved irrigation) work**

Variables	Yes	No	Total
	N (%)	N (%)	N (%)
All	98 (92.5)	8 (7.5)	
Yilo Krobo	42 (91.3)	4 (8.7)	106 (100)
Huhunya	15 (83.3)	3 (16.7)	46 (100)
Obawale	3 (100)	0 (0)	18 (100)
Akorley	24 (96)	1 (4)	3 (100)
			25 (100)
Wa West	56 (93.3)	4 (6.7)	60 (100)
Siiru	37 (94.9)	2 (5.1)	39 (100)
Dabo	15 (93.8)	1 (6.3)	16 (100)
Siriyiri	4 (80)	1 (20)	5 (100)
Gender			
Male	58 (95.1)	3 (4.9)	61 (100)
Female	40 (88.9)	5 (11.1)	45 (100)
Total	98 (92.5)	8 (7.5)	106 (100)

Source: Fieldwork, 2022

According Schipper (2020), determining whether a particular adaptation strategy has been effective is often difficult. This difficulty is usually associated with the complementary nature of an adaptation strategy as a process and an outcome (Bennett et al., 2017). Hence, to understand if a strategy was effective or maladaptive, one has to take into consideration the expectations of farmers, human behaviours and the understanding of risks (Claudet et al., 2020; Juhola et al., 2016; Magnan et al., 2016). Again, the contextual nature of adaptation strategy does not enable one to easily have a universal definition on what constitutes an “effective” adaptation strategy (Singh et al., 2021). Despite these epistemological constraints, this study sought the viewpoint of farmers on whether the strategy adopted worked for them or not. This was to gain a gender and spatial perspective on farmers’ viewpoint of the workability of the strategy employed and whether it achieved its desired outcome. The researcher assumes in this case that, farmers who state that the

strategy worked implied that the strategy had met their expectation by tackling the specifics of the goals it was meant for, depending on the type of adaptation strategy and the limited risks involved.

In this study, respondents who adopted irrigation were asked if the strategy worked for them. Overall, 92.5% of the respondents agreed that it worked. Since irrigation is often used to supplement water supply especially in the rural households that rely on rain-fed agriculture. It suggests that farmers who adopted the strategy had water supplied to their farms. When differentiated by districts, 91.3% of respondents in Yilo Krobo stated that the strategy worked as compared to 93.3% of respondents from Wa West. It is seen here that though the respondents from Yilo Krobo had stated through survey about a lack of finance and inadequate help from the government concerning the strategy, they reported a high number of respondents stating the strategy worked. This was indicative that when the right structures and mechanisms are put in place, more farmers are likely to adopt it. Interestingly, across communities studied, in Obawale, a 100% stated that the strategy worked, whereas the other two communities recorded a significantly higher percentage of respondents who believed that the strategy worked.

On the other hand, a significantly higher percentage of male respondents (95.1%) believed that it worked as compared to 88.9% of female respondents. This was not surprising since most women are more likely to face constraints in adopting the strategy. For instance, land tenure systems in most rural communities do not favour the women because of the patriarchal systems in place that enforce traditional norms against women (Chigbu, 2019). As such, women are more likely to have access to their husbands' land as compared to getting their own. Furthermore, high temperatures and little rainfall means that women would have to provide water in their since they have a primary duty of being caregivers whilst providing water for their farms (Boedecker et al., 2019). The arduous activity tends to prove too strenuous for them and as such might not be able to fully devote

resources into the strategy thereby deriving its full benefits. Furthermore, financial constraints limit their ability to purchase irrigation inputs like pumps or to dig water canals (Bryan & Lefore, 2021). In instances where they can afford some inputs, the inadequate provision from government particularly in the Yilo Krobo district limits and reduces their adaptive capacity and prevents them from fully benefitting from the strategy.

5.2 Adoption of farming less land

Among the other in-situ adaptation strategies, adopting less farmlands or reducing farmland sizes was one that was quite popular among farmers across the two regions. In the Northern Savannah zone, it is quite common for farmers to own multiple farmlands (Abdullahi, 2020). Sometimes, it is as a result of the inheritance systems whereby inherited farmlands maybe located in different places (Bonye, 2022). There are certain instances whereby a farmer cannot occupy a land close to them even if it is not utilized because of land tenure system; hence, it is better to farm on another piece of land in addition to theirs (Dumba et al., 2020; Pardoe et al., 2016). This however, attracts extra cost in the purchase of fuel for transport in between farms or in the maintenance of bicycles. Unpredictable climatic variation and poor crop yield results in the decline of household incomes (Nthambi & Ijioma, 2021). Therefore, maintaining a much bigger farm or multiple farms requires a much higher input resulting in much more expenses (Kumasi et al., 2017). Again, larger farm sizes require more labour.



Table 5.2a: Adopting less farming land

	Male		Female		All	
	Adopted	Not adopted	Adopted	Not adopted	Adopted	Not adopted
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
All	109 (44.9)	134 (55.1)	114 (50.4)	112 (49.6)	223 (47.5)	246 (52.5)
Yilo Krobo	36 (29.8)	85 (70.2)	38 (34.9)	71 (65.1)	74 (32.2)	156 (67.8)
Huhunya	21 (47.7)	23 (52.3)	19 (50)	19 (50)	40 (48.8)	42 (51.2)
Obawale	6 (19.4)	25 (80.6)	3 (10)	27 (90)	9 (14.8)	52 (85.2)
Akorley	9 (19.6)	37 (80.4)	16 (39)	25 (61)	25 (28.7)	62 (71.3)
Wa West	73 (59.8)	49 (40.2)	76 (65)	41 (35)	149 (62.3)	90 (37.7)
Siiru	22 (64.7)	12 (35.3)	28 (77.8)	8 (22.2)	50 (71.4)	20 (28.6)
Dabo	17 (41.5)	24 (58.5)	19 (47.5)	21 (52.5)	36 (44.4)	45 (55.6)
Siriyiri	34 (72.3)	13 (27.7)	29 (70.7)	12 (29.3)	63 (71.6)	25 (28.4)
P-values (District)	$\chi^2 = 22.2275$ Pr = 0.000		$\chi^2 = 20.4448$ Pr = 0.000		$\chi^2 = 42.7746$ Pr = 0.000	
P-values (community)	$\chi^2 = 40.1518$ Pr = 0.000		$\chi^2 = 39.4209$ Pr = 0.000		$\chi^2 = 75.4156$ Pr = 0.000	

Source: Fieldwork, 2022.

In this study, 47.5% of farmers across regions adopted the strategy. With gender, about 50.4% of female farmers as compared to 44.9% of men opted to adopt the strategy. Though the percentage between genders was relatively less, it reflected the economic disparity and how certain structures such as the economic or culture either proved disadvantageous towards women and/or enabled the facilitation of resources for them when adopting a strategy. As established in earlier sections, women often owned or rented lesser farm sizes due to traditional land tenure system, inheritance systems or financial constraints which disempowered them from getting larger farm sizes. According to Obayelu et al. (2020), women were more likely to reduce farm sizes due to poorer economic base in order to cope with changes in the environment. For example, female farmers' inability to hire more farm labour for tillage practice also reflected in their inability to buy or rent farm machinery. Therefore, they were compelled to farm less crops and further reduce land sizes.

When spatially differentiated, a higher percentage (62.3%) of respondents in the Wa West adopted the strategy as compared to 32.2% of respondents in Yilo Krobo. These differences may be explained by the harsh climatic conditions as well as the weaker economic structures in the Wa West district (Fuseini et al., 2019). This may imply that, farmers in the Wa West district may face high expenses in farm management and maintenance. Hence compelling more farmers to adopt the use of fewer farmlands in order to reduce farm production costs as compared to those in the Yilo Krobo district.

Reasons for not adopting strategy

Table 5.2b: Reasons for not adopting less farmland

	Yilo Krobo			Wa West			All		
	Male	Female	All	Male	Female	All	Male	Female	All
	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)
Lack of finance	2 (2.53)	3 (4.55)	5 (3.45)	4 (8.7)	7 (17.95)	11 (12.94)	6 (4.8)	10 (9.52)	16 (6.96)
Lack of information	1 (1.27)	2 (3.03)	3 (2.07)	6 (13.04)	5 (12.82)	11 (12.94)	7 (5.6)	7 (6.67)	14 (6.09)
It would not help	76 (96.2)	61 (92.42)	137 (94.48)	42 (91.3)	33 (84.62)	75 (88.24)	118 (94.4)	94 (89.52)	212 (92.17)
The land is not owned by us	0 (0)	1 (1.52)	1 (0.69)	0 (0)	1 (2.56)	1 (1.18)	0 (0)	2 (1.9)	2 (0.87)
Other reason	3 (3.8)	1 (1.52)	4 (2.76)	3 (6.52)	3 (7.69)	6 (7.06)	6 (4.8)	4 (3.81)	10 (4.35)
Total valid cases	79 (103.8)	66 (103.03)	145 (103.45)	46 (119.57)	39 (125.64)	85 (122.35)	125 (109.6)	105 (111.43)	230 (110.43)

Source: Fieldwork, 2022.

Respondents were probed further on their reason for not adopting the strategy. **Table 5.2b** reveals that a significantly high percentage of the respondents stated that it would not work. Out of this figure, 94.4% of the respondents were males whereas 89.52% were females. When spatially differentiated by districts, 96.2% of the males in Wa West believed that it would not help as compared to 92.42% of females. This was in comparison with 84.62% of females and 91.3% of male respondents in Wa West.

The results imply that, a large percentage of the farmers had reduced farm sizes in order to lower expenses, may still have a higher expenditure despite a smaller farm size. As noted in Obasi and Kanu (2014), it is shown that it was much easier for men to hire more farm labour due to easier access to financial mechanisms. On the other hand, women with larger farm sizes have to rely on household labour which was cheaper. This is however, not feasible since most household labour was distracted by schooling or other responsibilities:

“Oh, I have a farm. It is almost one acre but I use it for vegetable and some one or two crops. I want to start a yam farm. But it is difficult... My husband has been able to hire some labourers from the other farms. My children used to help on vacation but the eldest is currently in boarding school. The younger one is in Junior High School, after school he goes for classes and then looks after the shop. There’s no one to help. Sometimes I help my husband on his farm with hopes that he would lend some of his labourers to me, but they work on fixed pay so that is another expense as well” (29 year old, female farmer, Huhunya).

The statement above shows that, for smallholder farmers, the decision to reduce farm sizes or own lesser farms aids in better management and lesser expenses in farm input and labour. It also cuts down the cost involved in transporting between farmlands.

This further implies that though a reduction of a farmland meant lesser expenses, there were certain variables that could determine the efficiency and effectiveness of the strategy. Anang et al. (2016), postulate that these variables included from farm sizes, access to irrigation, extension officers as well as credit facilities required the efficiency of the strategy. This is because continuous climate variations meant farmers had to adopt ways and implement other services that would increase crop productivity as well as provide income (Ndamani & Watanabe, 2016).

Effectiveness of adopting less farmland

Table 5.2c: did the strategy work

Variables	Yes	No	Total
	N (%)	N (%)	N (%)
All	134 (60.1)	89 (39.9)	223 (100)
Yilo Krobo	50 (67.6)	24 (32.4)	74 (100)
Huhunya	25 (62.5)	15 (37.5)	40 (100)
Obawale	4 (44.4)	5 (55.6)	9 (100)
Akorley	21 (84)	4 (16)	25 (100)
Wa West	84 (56.4)	65 (43.6)	149 (100)
Siiru	21 (42)	29 (58)	50 (100)
Dabo	27 (75)	9 (25)	36 (100)
Siriyiri	36 (57.1)	27 (42.9)	63 (100)
Gender			
Male	67 (61.5)	42 (38.5)	109 (100)
Female	67 (58.8)	47 (41.2)	114 (100)
Total	134 (60.1)	89 (39.9)	223 (100)

Source: Fieldwork, 2022

In most cases, the strategy is adopted to reduce expenses and high level farm production cost (Obasi & Kanu, 2014). In this study, 60.1% of the respondents agreed the strategy worked. This however may show that the adoption of less farmland does not necessarily mean a reduction in the cost of farm level production. This is because the reflection of global market price hikes on the

local market means that prices of farm inputs such as fertilizer, tools and other relevant farm materials are likely to increase (Holden, 2019). Furthermore, if temperatures continue to be on the rise and rainfall becoming increasingly unpredictable, it is probable that reducing farmland size would not prove adequate. Therefore, farmers would have to adopt other strategies. On the other hand, when differentiated via districts 67.6% of the respondents in Yilo Krobo as compared to 56.4% of the respondents who believed that it worked.

Gender wise, although a significantly higher percentage of women stated that they adopted the strategy, a significantly higher percentage of male respondents stated that the strategy worked as compared to the female respondents. As established earlier, most women are more likely to adopt the strategy due to poor economic strength (Obasi & Kanu, 2014). Yet in a paradoxical way, poor economic strength also prevents an efficient and effective adoption of the strategy. In addition, a reduction in farm sizes also means a higher propensity to have lower or reduced crop yield. In addition, an increase in global and national prices is likely to increase the prices of farm production. Furthermore, a continuous change in climate would mean that women who would be much more vulnerable are compelled to adopt other cost effective strategies.

5.3 Adopting improved or new crop varieties

Another strategy often adopted by farmers the adoption of improved or new crop varieties. It is believed that the adoption of ‘certified and improved high-yielding crops’ aids in the improvement of agricultural productivity and also improves the standard of living of farmers in developing countries (Chandio & Yuoasheng, 2018: 103). The planting of crop varieties that are resistant to high temperatures are quite common in Northern Savannah Zone (Derbile et al., 2016). This

includes traditionally known varieties like millet or hybrid by the government. In order to cope with increasing climate variations, some farmers adopt improved or new crop varieties.

Table 5.3a: Adopting Improved or new crop varieties

	Male		Female		All	
	Adopted	Not adopted	Adopted	Not adopted	Adopted	Not adopted
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
All	163 (67.1)	80 (32.9)	122 (54)	104 (46)	285 (60.8)	184 (39.2)
Yilo Krobo	72 (59.5)	49 (40.5)	51 (46.8)	58 (53.2)	123 (53.5)	107 (46.5)
Huhunya	26 (59.1)	18 (40.9)	22 (57.9)	16 (42.1)	48 (58.5)	34 (41.5)
Obawale	19 (61.3)	12 (38.7)	8 (26.7)	22 (73.3)	27 (44.3)	34 (55.7)
Akorley	27 (58.7)	19 (41.3)	21 (51.2)	20 (48.8)	48 (55.2)	39 (44.8)
Wa West	91 (74.6)	31 (25.4)	71 (60.7)	46 (39.3)	162 (67.8)	77 (32.2)
Siiru	25 (73.5)	9 (26.5)	25 (69.4)	11 (30.6)	50 (71.4)	20 (28.6)
Dabo	31 (75.6)	10 (24.4)	16 (40)	24 (60)	47 (58)	34 (42)
Siriyiri	35 (74.5)	12 (25.5)	30 (73.2)	11 (26.8)	65 (73.9)	23 (26.1)
P-values (District)	$\chi^2 = 6.2607$ Pr = 0.012		$\chi^2 = 4.3856$ Pr = 0.036		$\chi^2 = 10.0591$ Pr = 0.002	
P-values (community)	$\chi^2 = 6.3595$ Pr = 0.273		$\chi^2 = 22.0607$ Pr = 0.001		$\chi^2 = 18.2074$ Pr = 0.003	

Source: Fieldwork, 2022

Data from the study in (Table 5.3a) shows that across regions 60.8% of the respondents adopted improved or new crop varieties. It is worthy of note that 67.1% of the male respondents across regions adopted this strategy as compared to 54% female respondents. Male respondents are more likely to adopt new crop varieties such as drought resistant crops. This is likely because of most male farmers' access to resources, which empowers them financially to attain improved or new crop varieties. When spatially differentiated by districts, 59.5% of the male respondents in Yilo Krobo adopted the strategy as compared to 74.6% of the males in Wa West. On the hand, 46.8% of the females in Yilo Krobo adopted the strategy as compared to 60.7% of the female respondents who adopted the strategy. It can be determined that a larger percentage of the respondents in the

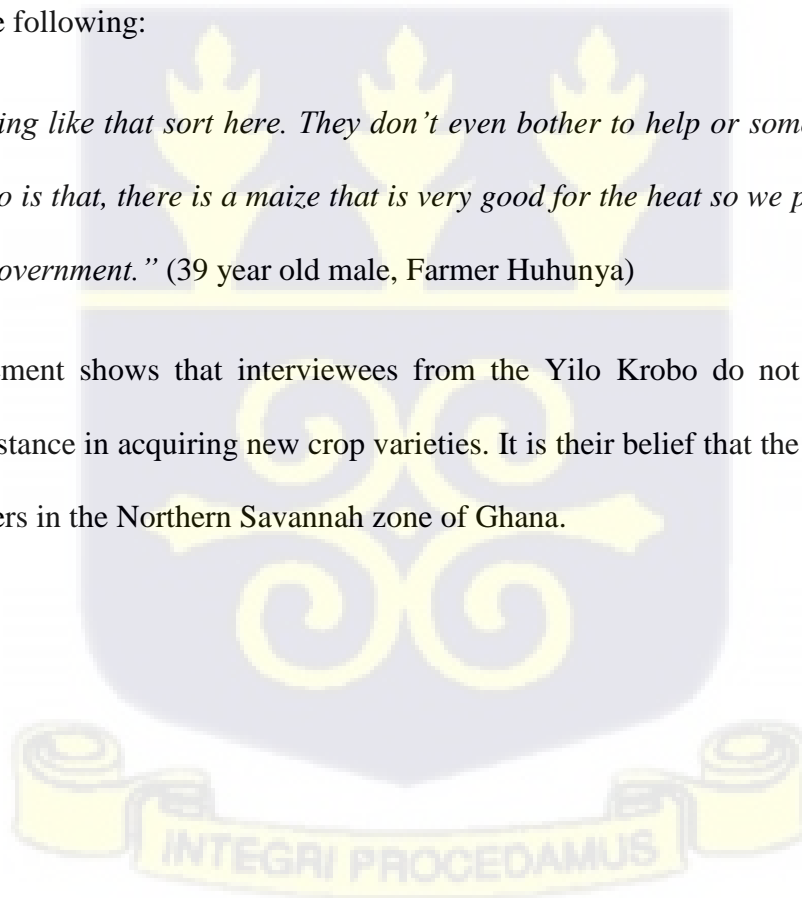
Wa West district adopted this strategy as compared to the respondents from the Yilo Krobo district. Earlier works like Yaro (2004) and Derbile (2010) suggests that, farmers in the Northern Savannah Zone are accustomed to both indigenous and modernized crop varieties that aid with dry spells. Furthermore, a qualitative analysis carried out in both regions suggests that farmers in the Wa West district are more likely to get government support as compared to farmers in the Yilo Krobo district. This was quoted by a farmer in Akorley:

“They don’t care, all they care about is farmers in the North. They send the watermelon seeds and fertilizers over there” (35 year old Farmer, Akorley)

Another state the following:

“...there is nothing like that sort here. They don’t even bother to help or something of that sort here. What we do is that, there is a maize that is very good for the heat so we plant that. But that is not from the government.” (39 year old male, Farmer Huhunya)

The above statement shows that interviewees from the Yilo Krobo do not receive adequate government assistance in acquiring new crop varieties. It is their belief that the government often focuses on farmers in the Northern Savannah zone of Ghana.



*Reasons why strategy was not adopted***Table 5.3b: Reasons why improved or new crop varieties did not work**

	Yilo Krobo			Wa West			All		
	Male	Female	All	Male	Female	All	Male	Female	All
	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)
Lack of finance	6 (12.77)	17 (30.36)	23 (22.33)	24 (77.42)	36 (78.26)	60 (77.92)	30 (38.46)	53 (51.96)	83 (46.11)
Lack of information	18 (38.3)	34 (60.71)	52 (50.49)	12 (38.71)	16 (34.78)	28 (36.36)	30 (38.46)	50 (49.02)	80 (44.44)
It would not help	19 (40.43)	13 (23.21)	32 (31.07)	4 (12.9)	3 (6.52)	7 (9.09)	23 (29.49)	16 (15.69)	39 (21.67)
Other reason	10 (21.28)	8 (14.29)	18 (17.48)	3 (9.68)	5 (10.87)	8 (10.39)	13 (16.67)	13 (12.75)	26 (14.44)
Total valid cases	47 (112.77)	56 (128.57)	103 (121.36)	31 (138.71)	46 (130.43)	77 (133.77)	78 (123.08)	102 (129.41)	180 (126.67)
P-values	$\chi^2 = 13.8971$ Pr = 0.053			$\chi^2 = 2.8149$ Pr = 0.728			$\chi^2 = 9.8931$ Pr = 0.195		

Source: Fieldwork, 2022

Farmers who did not adopt the strategy were probed further to understand why they did not adopt the strategy. The results are shown in **Table 5.4b**. A significant percentage of the respondents (46.11%) across regions stated that lack of finance was a reason for their failure to adopt the strategy. A farmer in Dabo complained:

“Yes. Those who have the financial background usually go to the agriculture extension officer or shops to go and buy improve seeds per the education given by the agriculture extension officers. Improve seeds are very costly to buy” (45 year old farmer, Dabo)

This suggests that poor economic structures disempower farmers from acquiring new seeds or to gain access to the agriculture extension officer.

Consequently, in reference to gender a larger percentage of women as compared to men did not adopt the strategy due to a lack of finance. Although this was not a problem peculiar to a specific gender. Some female farmers were however much more likely to have difficulty in adopting this strategy due to financial constraints. As noted in Swami and Parthasarathy (2021) study on adaptation strategies in rural India, adoption of new and improved crop varieties are made much easier when farmers have access to a credit facility. This notwithstanding, Gebre et al. (2019) carried out a research in Ethiopia and established that female farmers have fewer income sources. In this study for instance, the primary source of most farmers' incomes was from crop sales. Despite this, existing gender disparity in farming encouraged men to grow commercial and fruit trees, or in some instances inherit commercial farms which were likely to generate more funds as compared to women who were likely to cultivate vegetable farming:

“I am currently farming on my okra farm. I sometimes grow tomatoes and onions. Once in a while lettuce. The rains have spoiled the roads so by the time it gets to the city it is spoiled and there is no profit... my husband, shares a mango farm with his brothers so they sometimes sell it to blue skies [factory] when the harvest is good” (22 year old, female farmer, Akorley)

Based on such disparity, most male farmers were more likely to get a diverse source of income as compared to female farmers. This consequently empowered the financial capacity of men enabling them to invest in newly improved crop varieties. This is in line with findings on agricultural development in Northern Ghana by Quaye et al. (2019). In their study, they established that male farmers were more likely to adopt improved crop varieties due to their better financial standing, bigger farmlands, access to easier mobility, and access to agricultural extension services. Regardless, there were certain occasions whereby female farmers showed resourcefulness and agency in order to acquire improved crop varieties. For instance, female respondents particularly

those in the Upper West had access to government resources that provided and in certain instance subsidized improved crop varieties. This is quoted below:

“Some years ago women did not have the means to buy some seedlings unless their husbands and uncles provided them. Some don’t have money to buy but they sometimes save money or join local susu [savings] groups so that they can buy the seeds from the agriculture officer” (45 year old, Male farmer from Dabo).

“Yes. Those of us who have the enough money usually go to the agriculture extension officer or shops to go and buy improved seeds but they can be very expensive to buy” (30 year Farmer from Siriyiri)

In comparison, 44.44% of respondents stated that they did not adopt the strategy due to the lack of information on the strategy. Of this percentage, 49.02% were females whereas, 38.46% were men. This was further explained during focus group discussions, where some female respondents in the Yilo Krobo district had complained of not knowing of improved crop varieties. This is stated below:

“No, the government has not supported us with any improved seeds. This is even the first time I am hearing something about new improved seed varieties” (Akorley youth FGD).

The statement above, points out that some farmers were unable to adopt a strategy due to the lack of information on the strategy. As illustrated in Bawakyillenuo et al. (2016), a good information flow was a key component in farmers adopting a strategy. On the other hand, there were some farmers in the Yilo Krobo district who had heard of the strategy, but had other reasons why they did not adopt the strategy:

“Yes, I have different varieties of maize. There is one that does not grow tall. It is very short and quite drought tolerant. But as the plant is very short, rodents usually eat the grains. There is another one that grows very tall and produces bigger cobs and wide grains if fertilizer is applied to the plant. The problem with that is that if there is a storm, most of them would break or fall off” (32 year old, Farmer from Akorley).

As pointed out in the above statement, although some had access to different varieties of maize, there were some disadvantages associated with their usage. For instance, some varieties though tolerant of the high temperatures, were short and accessible to rodents. Others were tall yet had weak stems that could easily break off. This therefore sometimes created more costs for the farmers.

Effectiveness of new or improved crop variety

Table 5.3c: did the strategy work

Variables	Yes	No	Total
	N (%)	N (%)	N (%)
All	262 (91.9)	23 (8.1)	285 (100)
Yilo Krobo	116 (94.3)	7 (5.7)	123 (100)
Huhunya	46 (95.8)	2 (4.2)	48 (100)
Obawale	26 (96.3)	1 (3.7)	27 (100)
Akorley	44 (91.7)	4 (8.3)	48 (100)
Wa West	146 (90.1)	16 (9.9)	162 (100)
Siiru	45 (90)	5 (10)	50 (100)
Dabo	45 (95.7)	2 (4.3)	47 (100)
Siriyiri	56 (86.2)	9 (13.8)	65 (100)
Gender			
Male	152 (93.3)	11 (6.7)	163 (100)
Female	110 (90.2)	12 (9.8)	122 (100)
Total	262 (91.9)	23 (8.1)	285 (100)

Source: Fieldwork, 2022

A significantly large percentage (91.9%) of respondents agreed that the strategy worked. This means that farmers who adopted the strategy in hopes of having drought resistant crops and crops with stronger stems against strong winds were able to achieve that from the adopting the strategy.

When differentiated by districts, most respondents in Yilo Krobo believed that the strategy worked as compared to the respondents in Wa West. In relation to gender, (93.3% of the male respondents said the strategy worked as compared to 90.2% of respondents. Regardless of the differences in percentages, the chi square test conducted among gender showed that it was statistically insignificant.

5.4 Use of more Pesticides and fertilizers

Climate change has resulted in shorter growing seasons for crops. In some instances, it has brought about an increase in certain pests and diseases. For example, in the Yilo Krobo district, due to rainfall variability, some mangoes develop bacterial black spot (BBS). This disease affects the leaves and stems of the mango seedlings and often times, can affect about 90% of the fruit and make them unsuitable for the commercial market. This causes financial to farmers and increases food insecurity. There are certain occasions including either insufficient rainfall or too much rainfall, which could cause surface run off resulting in soil erosion. This encourages the loss of land fertility. In a bid to adapt to such changes, some farmers adopt the use of more pesticides and fertilizers to battle with crop diseases and soil infertility.

Table 5.4a: Adoption of more pesticides and fertilizers

	Male		Female		All	
	Adopted	Not adopted	Adopted	Not adopted	Adopted	Not adopted
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
All	180 (74.1)	63 (25.9)	127 (56.2)	99 (43.8)	307 (65.5)	162 (34.5)
Yilo Krobo	88 (72.7)	33 (27.3)	46 (42.2)	63 (57.8)	134 (58.3)	96 (41.7)
Huhunya	36 (81.8)	8 (18.2)	22 (57.9)	16 (42.1)	58 (70.7)	24 (29.3)
Obawale	19 (61.3)	12 (38.7)	5 (16.7)	25 (83.3)	24 (39.3)	37 (60.7)
Akorley	33 (71.7)	13 (28.3)	19 (46.3)	22 (53.7)	52 (59.8)	35 (40.2)
Wa West	92 (75.4)	30 (24.6)	81 (69.2)	36 (30.8)	173 (72.4)	66 (27.6)
Siiru	29 (85.3)	5 (14.7)	34 (94.4)	2 (5.6)	63 (90)	7 (10)
Dabo	24 (58.5)	17 (41.5)	17 (42.5)	23 (57.5)	41 (50.6)	40 (49.4)
Siriyiri	39 (83)	8 (17)	30 (73.2)	11 (26.8)	69 (78.4)	19 (21.6)
P-values	$\chi^2 = 0.2276$ Pr = 0.633		$\chi^2 = 16.7471$ Pr = 0.000		$\chi^2 = 10.3411$ Pr = 0.001	

Source: Fieldwork, 2022

Table 5.4a indicates that across regions, over 50% of the respondents adopted the strategy as compared to 34.5% of the respondents who did not adopt it. When differentiated by gender, within each district, 72.7% of the male respondents in Yilo Krobo adopted the strategy; and this was higher than 42.2% of female respondents who adopted the strategy. Equally, in Wa West, the percentage of male respondents who adopted the strategy was of a slightly higher percentage than women. These results were not surprising since most studies show that a significant number of male farmers had a higher affinity to adopting the use of pesticides and insecticides. In Zinyemba et al. (2021), where smallholder cotton farmers in Zimbabwe were investigated, it was realized that a higher percentage of male farmers used pesticides as compared to their female counterparts. It also reflects findings from Denkyirah et al. (2017) study on cocoa farmers' adaptation strategies in Ghana. In the study, the authors showed that female farmers were less likely to not use pesticides

and fertilizers. This was because of the implications it might have on their reproductive health. This reason is however, in contrast to studies by Zinyemba et al. (2021) who argue that women did not use pesticides due to inadequate finance.

In this study, there were certain instances where women did not adopt the strategy by virtue of their gender in other cases some male farmers argued that due to the expenses, it is much more prudent for the women in most cases, their wives, to aid in the mixing of pesticides and fertilizers. The following statements were captured by male farmers in both districts:

“In applying pesticides and liquid fertilizers, she helps me by fetching water and mixing the chemicals. I do not allow her to apply the chemicals. She also helps me in weeding...” (56 years old male farmer, Obawale)

“The pesticides and fertilizers are very expensive. Even for men. The last time we received subsidies was two years ago. So it doesn’t make sense for women to patronize it. Most do not have money for it. Besides its not healthy it’s safer for men to use and protect the women from the chemicals” (26 year old male farmer, Siiru)

The researcher believes that another reason that could be responsible for the huge disparity between men and women adopting the strategy across regions and within districts is likely to be the hike in prices of fertilizers and pesticides as reported by the National Food Buffer Stock Company (NAFCO) in 2023, (nafco.gov.gh). This will make it difficult for female farmers to patronize.



*Reasons for not adopting strategy***Table 5.4b: Reasons for not adopting the use of pesticides**

	Yilo Krobo			Wa West			All		
	Male	Female	All	Male	Female	All	Male	Female	All
	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)
Lack of finance	11 (33.33)	50 (81.97)	61 (64.89)	26 (86.67)	32 (91.43)	58 (89.23)	37 (58.73)	82 (85.42)	119 (74.84)
Lack of information	0 (0)	2 (3.28)	2 (2.13)	1 (3.33)	1 (2.86)	2 (3.08)	1 (1.59)	3 (3.13)	4 (2.52)
It would not help	19 (57.58)	9 (14.75)	28 (29.79)	1 (3.33)	2 (5.71)	3 (4.62)	20 (31.75)	11 (11.46)	31 (19.5)
Other reason	6 (18.18)	2 (3.28)	8 (8.51)	3 (10)	2 (5.71)	5 (7.69)	9 (14.29)	4 (4.17)	13 (8.18)
Total valid cases	33 (109.09)	61 (103.28)	94 (105.32)	30 (103.33)	35 (105.71)	65 (104.62)	63 (106.35)	96 (104.17)	159 (105.03)
P-values	$\chi^2 = 30.8440$ Pr = 0.000			$\chi^2 = 1.6578$ Pr = 0.798			$\chi^2 = 19.2498$ Pr = 0.007		

Source: Fieldwork, 2022.

Table 5.4b, indicates that a significantly high percentage of respondents across regions did not adopt the strategy due to lack of finance. Of this figure, over 70% of female respondents and 58.73% of male respondents stated a lack of finance as a reason for not adopting the strategy. Focus group discussions between districts show that farmers in Wa West were more likely to adopt the strategy as compared to the respondents in the Eastern due to subsidies provided by the government. As quoted below:

“The government does not help in anyway; we incur losses because farm inputs are very expensive these days. We spend a lot of money on fertilizers, weedicides and pesticides. We hire labour to help us apply these inputs on the farm. So, when we get low yield, we are not even able to cover the cost of production” (Key informant, Huhunya)

Other participants in focus group discussion in Obawale are quoted as saying:

“Now, we do not get subsidised fertilisers to buy. The programme has been cancelled”

(Respondent, Female FGD, Obawale)

“Even when the programme was running, it was hoarded by political party foot soldiers”

(respondent female FGD, Obawale)

The above quotes indicate that, there was a programme that provided subsidized pesticides and fertilizer. Yet, the programme had been brought to a halt. This was in contradiction to an Eastern region agricultural extension officer, who stated the opposite:

“Oh we have subsidized pesticides and fertilizers. It is readily available for the farmers and they can walk to any of the offices to get it” (Agricultural extension officer, Eastern Region).

In comparison, a Wa West respondent is quoted as saying:

“Oh the government subsidies the pesticides and the fertilizers, so the little you have you can just manage to check ‘your’ how far. It is not all great but it better than nothing” (Siriyiri Focus group discussion)

Table 5.4b also shows that 19.5% of the respondents who stated that it would not work and 8.18% who stated that other reasons other than the options provided were the reasons why they did not adopt the strategy.

When spatially differentiated by districts, a higher number of respondents in Yilo Krobo believed that the strategy would not work compared to a significantly lower percentage of respondents in Wa West (4.62%). Respondents who adopted the strategy were further asked if the strategy

worked. That is, if it achieved the aim of reducing pest infestation as well as an increase in soil fertility. This is seen in **Table 5.4c** below.

Effectiveness of using more pesticides

Table 5.4c: did the strategy work

Variables	Yes	No	Total
	N (%)	N (%)	N (%)
All	281 (91.5)	26 (8.5)	307 (100)
Yilo Krobo	125 (93.3)	9 (6.7)	134 (100)
Huhunya	51 (87.9)	7 (12.1)	58 (100)
Obawale	24 (100)	0 (0)	24 (100)
Akorley	50 (96.2)	2 (3.8)	52 (100)
Wa West	156 (90.2)	17 (9.8)	173 (100)
Siiru	59 (93.7)	4 (6.3)	63 (100)
Dabo	40 (97.6)	1 (2.4)	41 (100)
Siriyiri	57 (82.6)	12 (17.4)	69 (100)
Gender			
Male	169 (93.9)	11 (6.1)	180 (100)
Female	112 (88.2)	15 (11.8)	127 (100)
Total	281 (91.5)	26 (8.5)	307 (100)

Source: Fieldwork, 2022

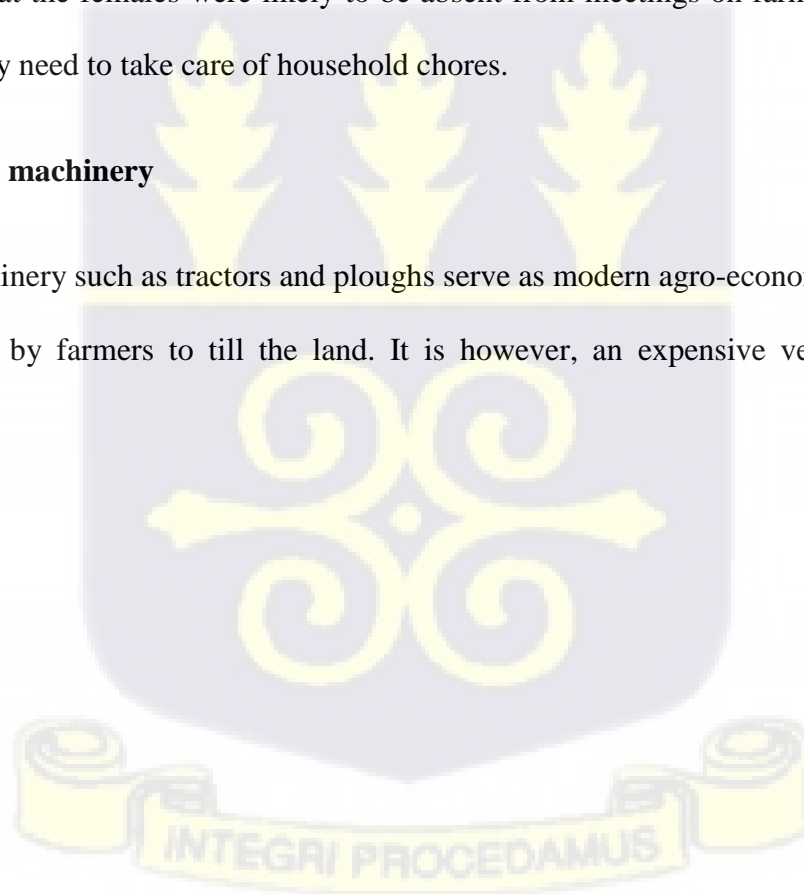
Across districts, 91.5% of the respondents believed that it worked whereas 8.5% did not believe that it worked. When spatially differentiated by districts, 93.3% of respondents in Yilo Krobo and 90.2% of respondents in the Wa West district believed that the strategy worked. This was interesting because although field interviews highlighted the complaints of respondents from Yilo Krobo on poor government provision, the data suggest that farmers who were able to use their human agency to overcome structural restraints stated that the strategy worked. It further suggests

that with more structures put in place to increase the adaptive capacity of farmers in Yilo Krobo, more are likely to adopt and realize the effectiveness of the strategy.

In relation to gender, 93.9% of male respondents as compared to 88.2% of female respondents who believed that the strategy worked this was not unexpected because most male respondents adopted the strategy as compared to female respondents. Also financial constraints are likely to prevent women to effectively adopt the strategy due in sufficient application inputs. Also, inadequate information on application method is likely to prevent women from effectively adopting the strategy and yielding results. For instance, notes taken during the reconnaissance survey reveal that the females were likely to be absent from meetings on farming methods, this was because they need to take care of household chores.

5.5 Use of more machinery

The use of machinery such as tractors and ploughs serve as modern agro-economic practices. It is often employed by farmers to till the land. It is however, an expensive venture and capital intensive.



The table below shows farmers who adopted the strategy.

Table 5.5a: Use of more machinery

	Male		Female		All	
	Adopted	Not adopted	Adopted	Not adopted	Adopted	Not adopted
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
All	101 (41.6)	142 (58.4)	86 (38.1)	140 (61.9)	187 (39.9)	282 (60.1)
Yilo Krobo	19 (15.7)	102 (84.3)	16 (14.7)	93 (85.3)	35 (15.2)	195 (84.8)
Huhunya	3 (6.8)	41 (93.2)	0 (0)	38 (100)	3 (3.7)	79 (96.3)
Obawale	0 (0)	31 (100)	1 (3.3)	29 (96.7)	1 (1.6)	60 (98.4)
Akorley	16 (34.8)	30 (65.2)	15 (36.6)	26 (63.4)	31 (35.6)	56 (64.4)
Wa West	82 (67.2)	40 (32.8)	70 (59.8)	47 (40.2)	152 (63.6)	87 (36.4)
Siiru	31 (91.2)	3 (8.8)	29 (80.6)	7 (19.4)	60 (85.7)	10 (14.3)
Dabo	17 (41.5)	24 (58.5)	14 (35)	26 (65)	31 (38.3)	50 (61.7)
Siriyiri	34 (72.3)	13 (27.7)	27 (65.9)	14 (34.1)	61 (69.3)	27 (30.7)
P-values (District)	$\chi^2 = 66.3645$ Pr = 0.000		$\chi^2 = 48.7992$ Pr = 0.000		$\chi^2 = 114.4343$ Pr = 0.000	
P-values (community)	$\chi^2 = 97.5761$ Pr = 0.000		$\chi^2 = 79.9105$ Pr = 0.000		$\chi^2 = 175.9730$ Pr = 0.000	

Source: Fieldwork, 2022.

Data analysis from **Table 5.5a** shows that a significantly lower percentage (39.9%) of sampled farmers adopted this strategy. This was not unexpected since this required intensive capital. However, there were some farmers who improvised by taking loans to buy some inputs as captured in a farmer’s statement:

“In the worst case, we take loan from mango sellers to buy the heavy farm inputs” (Farmer from Akorley).

Data analysis shows that, across the districts, 41.6% of the male respondents adopted the strategy compared to 38.1% female farmers who adopted the strategy. This was expected, due to the capital-intensive nature of the strategy. A farmer had the following to say during in-depth interviews:

“The machines are very expensive. The spare parts alone are expensive. Usually the men can buy it because of loans; they can use their big farms as collaterals. But for the women it is not common to see a woman owning a tractor, where do you think that she will get that money from?” (73 year old Female farmer, Dabo).

The statement implies that most women had poor access to credit facilities. This restricted their financial rights to purchase machinery for their farms. Conversely, some farmers argued that though women did not have direct access to machinery for ploughing, some waited till the men were done in order to use theirs:

“We have access to them just when the farming becomes intense; [when the men are using them] most of us always wait for the men to finish ploughing their lands before we can also plough. And that has even made some us to always miss the planting time.” (37 years male Female farmer, Siiru).

As noted in the above statement, though some women were able to find ways to utilize some machinery for tillage purposes, this method was not effective since waiting for the men to be done could take a while depending on the effectiveness of the machine as well as the size of the land. As stated by the respondent above, this causes the women to end up with low farm yields for since they at times cultivate late.

When spatially differentiated by districts, 15.7% of men as compared to 14.7% of women in Yilo Krobo adopted the strategy. In Wa West, 60.2% of men adopted the strategy as compared to 59.8% women who adopted the strategy. A much more astute observation of the data shows that a significantly larger percentage of male respondents in Wa West adopted the strategy as compared to male farmers in the Yilo Krobo district. Likewise, for the sampled female farmers, a larger

percentage of the women respondents in Wa West adopted the strategy as compared to male respondents. The Wa West district has in past years used bullocks for land ploughing due to the nature of the soil. In recent years, many of the farmers have come to embrace mechanization in farming such as tractors, machines for planting and harrowing this reduces the physical stress associated with out-dated farming practices.

As noted earlier, a large percentage of respondents across regions did not adopt the strategy. Further enquiry was made to find out why they did not adopt the strategy. As shown in **Table 5.6b**,

Reasons for not adopting strategy

Table 5.5b: Reasons for not adopting the strategy

	Yilo Krobo			Wa West			All		
	Male	Female	All	Male	Female	All	Male	Female	All
	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)
Lack of finance	49 (49.49)	62 (71.26)	111 (59.68)	35 (89.74)	42 (91.3)	77 (90.59)	84 (60.87)	104 (78.2)	188 (69.37)
Lack of information	2 (2.02)	11 (12.64)	13 (6.99)	3 (7.69)	1 (2.17)	4 (4.71)	5 (3.62)	12 (9.02)	17 (6.27)
It would not help	51 (51.52)	25 (28.74)	76 (40.86)	3 (7.69)	4 (8.7)	7 (8.24)	54 (39.13)	29 (21.8)	83 (30.63)
The land is not owned by us	1 (1.01)	2 (2.3)	3 (1.61)	-	-	-	1 (0.72)	2 (1.5)	3 (1.11)
Other reason	8 (8.08)	5 (5.75)	13 (6.99)	1 (2.56)	1 (2.17)	2 (2.35)	9 (6.52)	6 (4.51)	15 (5.54)
Total valid cases	99 (112.12)	87 (120.69)	186 (116.13)	39 (107.69)	46 (104.35)	85 (105.88)	138 (110.87)	133 (115.04)	271 (112.92)
P-values	$\chi^2 = 32.4939$ Pr = 0.001			$\chi^2 = 2.7464$ Pr = 0.601			$\chi^2 = 23.4618$ Pr = 0.015		

Source: Fieldwork, 2022.

As expected, a significant percentage of respondents across regions stated lack of finance as reason why they did not adopt the strategy. Most attributed it to the high rental fees of tractors and some

of the required machinery. When spatially differentiated by districts, a larger percentage of respondents in Wa West stated that the lack of finance was the reason why they did not adopt the strategy as compared to respondents in Yilo Krobo. This is probably due to the high poverty rate in the Wa West district (Fagariba et al., 2018). In relation to gender, 78.2% of the female respondents across regions stated lack of finance as a reason for not adopting the strategy; this was followed by 21.8 % who believed that the strategy would not work. In furtherance, 60.87% of the male respondents stated a lack of finance, followed by 39.13% of the respondents who believed the strategies would not work. Nonetheless, chi square test conducted on the districts and community levels did not show any significant statistical difference. **Table 5.5c** shows respondents who thought that the strategy worked.

Effectiveness of using more machinery

Table 5.5c: did the strategy work.

Variables	Yes	No	Total
	N (%)	N (%)	N (%)
All	158 (84.5)	29 (15.5)	187 (100)
Yilo Krobo	30 (85.7)	5 (14.3)	35 (100)
Huhunya	1 (33.3)	2 (66.7)	3 (100)
Obawale	1 (100)	0 (0)	1 (100)
Akorley	28 (90.3)	3 (9.7)	31 (100)
Wa West	128 (84.2)	24 (15.8)	152 (100)
Siiru	45 (75)	15 (25)	60 (100)
Dabo	31 (100)	0 (0)	31 (100)
Siriyiri	52 (85.2)	9 (14.8)	61 (100)
Gender			
Male	88 (87.1)	13 (12.9)	101 (100)
Female	70 (81.4)	16 (18.6)	86 (100)
Total	158 (84.5)	29 (15.5)	187 (100)

Source: Fieldwork, 2022

Across the two regions, 84.5% of respondents who adopted the strategy believed that the strategy worked. Adoption of this strategy requires the use of machinery such as tractors and driven ploughs to help farmers work more easily and to plant their crop quickly, hence “capitalize on the heavy rains” (Pardoe et al., 2016: 50). However, insufficient rainfall causes the formation of harder soil, which will reduce the speed of ploughing, thereby increasing the risk of technical breakdowns or malfunctions. There might either be unavailability of some of these parts too be purchased or they are also very expensive hereby likely enlarging the budget of a rural farmer when the strategy is adopted. This could be considered maladaptive. The continual climate variability means a higher increase in temperature and a reason why some farmers stated that the strategy did not work:

“The tractor parts are very expensive, the other day I had to buy 10000 cedis engine. The fuel price is high. This engine in particular uses diesel fuel so it is quite expensive. If you are not careful you will use all your capital on the machine instead of the rest of the farm” (Male Farmer, 40 years, Dabo)

When spatially differentiated by districts, a majority of the respondents in both districts stated that the strategy worked. Again, in relation to gender, 87.1% of male respondents stated that it worked as compared to 81.4% of females who believed that it worked. Notwithstanding the differences between genders, the chi square test performed shows that there was no significant statistical difference.

5.6 Takes steps against soil erosion

There are times that land use characterized by agricultural expansion as well as deforestation could exacerbate the effect of soil erosion (Panta et al., 2020; Raj et al., 2022). Some occurrences such as extreme rainfall can cause some soil particles to separate because of the severe rain impact on

the soil. This could cause a soil surface run-off, resulting in rill or gully erosion (Zhu et al., 2019). Inadvertently, due to the washing away of the top soil, nutrients are washed away creating a total reduction of crop yields (Lal, 2014). As a means to combat with the effects, some farmers adopt some soil conservation techniques or take certain steps in order to conserve soil: this includes crop rotation, planting of cover crops and increase in tillage practices (Akinngbe & Irohibe, 2014).

Table 5.6a: Takes steps against soil erosion strategy

	Male		Female		All	
	Adopted	Not adopted	Adopted	Not adopted	Adopted	Not adopted
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
All	79 (32.5)	164 (67.5)	59 (26.1)	167 (73.9)	138 (29.4)	331 (70.6)
Yilo Krobo	25 (20.7)	96 (79.3)	15 (13.8)	94 (86.2)	40 (17.4)	190 (82.6)
Huhunya	7 (15.9)	37 (84.1)	5 (13.2)	33 (86.8)	12 (14.6)	70 (85.4)
Obawale	4 (12.9)	27 (87.1)	0 (0)	30 (100)	4 (6.6)	57 (93.4)
Akorley	14 (30.4)	32 (69.6)	10 (24.4)	31 (75.6)	24 (27.6)	63 (72.4)
Wa West	54 (44.3)	68 (55.7)	44 (37.6)	73 (62.4)	98 (41)	141 (59)
Siiru	22 (64.7)	12 (35.3)	26 (72.2)	10 (27.8)	48 (68.6)	22 (31.4)
Dabo	12 (29.3)	29 (70.7)	10 (25)	30 (75)	22 (27.2)	59 (72.8)
Siriyiri	20 (42.6)	27 (57.4)	8 (19.5)	33 (80.5)	28 (31.8)	60 (68.2)
P-values (District)	$\chi^2 = 15.4222$ Pr = 0.000		$\chi^2 = 16.6326$ Pr = 0.000		$\chi^2 = 31.4695$ Pr = 0.000	
P-values (community)	$\chi^2 = 29.4681$ Pr = 0.000		$\chi^2 = 54.6011$ Pr = 0.000		$\chi^2 = 76.2396$ Pr = 0.000	

Source: Fieldwork, 2022

Gender wise, lower percentage of women across both regions adopted the strategy as compared to men. That is, 32.5% of the male respondents across regions adopted the strategy as compared to 26.1% of the females. As noted in Sherka (2023) many women often do not actively participate in soil conservation techniques like preventing soil erosion, as a result of low livelihoods, family obligations as well as the short-term benefits. A female farmer in Huhunya, stated the following:

“I do not practice that. If the soil’s fertility reduces I will look for another way. I currently have a small farmland which is very far away. Even if I wanted to the strategy is very time consuming and expensive and the land is not mine so I cannot just do anything on it. I have to look after the children, cook in the house and take care of the house and I also have to help my husband out on his farm. So you see, when can I have the time to till the land? I cannot do it at all...” (40 year old female farmer, Huhunya)

The above statement indicates that traditional gender roles creates a conflicting schedule in which women’s primary care giver role serves as a structural constraint which discourages them from taking steps to prevent soil erosion. This may cause them to resort to harmful practices like the excessive use of fertilizers on farmlands which could cause soil degradation. The interviewee further highlighted that she rents her farmland which prevents her from actively engaging in some soil practices. This finding is in line with studies by Etongo et al. (2018), which states that land rights are key determinants to practicing soil conservation techniques. Farmers who own their farmland are more likely to take incentives to maintain and increase the productivity of the land. Consequently, farmers who own their land can readily use it as collateral in order to purchase equipment for soil conservation techniques. Other studies like Zhang et al. (2019) also points out that the farmers are more likely to take steps to prevent erosion if they have larger plots of land. The study further states that farmers are more likely to adopt this strategy if their homestead is closer to farmlands; this is because farmers can lose much time walking the distance to their farms. As established earlier in this study, cultural structures like the traditional inheritance systems discourage women from having access to location-friendly lands. As a result of these gender-based constraints, women are less likely to engage in the prevention of soil erosion.

When spatially differentiated, a higher percentage of the respondents in Wa West adopted the strategy as compared to 17.4% in Yilo Krobo. Farmers in Yilo Krobo had a significantly lower percentage of female farmers as compared to a significantly higher percentage of female respondents in Wa West, who adopted the strategy. A reason for such spatial differential could be due to the location of the two districts in different agro ecological zones. Places in arid and semi-arid regions, as is the case of the Upper West often experience significantly higher cases of soil erosion as compared to places in the Forest zone due to the topography of the land and the sparse vegetation. Nonetheless, this does not exclude them from the experience.

Reasons for not adopting strategy

Tables 5.6b: Reasons for not taking steps against erosion

	Yilo Krobo			Wa West			All		
	Male N (%)	Female N (%)	All N (%)	Male N (%)	Female N(%)	All N (%)	Male N(%)	Female N (%)	All N (%)
Lack of finance	11 (14.47)	12 (17.14)	23 (15.75)	8 (16.67)	7 (13.73)	15 (15.15)	19 (15.32)	19 (15.7)	38 (15.51)
Lack of information	10 (13.16)	11 (15.71)	21 (14.38)	25 (52.08)	36 (70.59)	61 (61.62)	35 (28.23)	47 (38.84)	82 (33.47)
It would not help	48 (63.16)	41 (58.57)	89 (60.96)	18 (37.5)	12 (23.53)	30 (30.3)	66 (53.23)	53 (43.8)	119 (48.57)
The land is not owned by us	4 (5.26)	3 (4.29)	7 (4.79)	0 (0)	1 (1.96)	1 (1.01)	4 (3.23)	4 (3.31)	8 (3.27)
Other reason	8 (10.53)	11 (15.71)	19 (13.01)	7 (14.58)	9 (17.65)	16 (16.16)	15 (12.1)	20 (16.53)	35 (14.29)
Total valid cases	76 (106.58)	70 (111.43)	146 (108.9)	48 (120.83)	51 (127.45)	99 (124.24)	124 (112.1)	121 (118.18)	245 (115.1)
P-values	$\chi^2 = 7.0719$ Pr = 0.630			$\chi^2 = 15.4890$ Pr = 0.050			$\chi^2 = 17.6494$ Pr = 0.090		

Source: Fieldwork, 2022.

Table 5.6b indicates that a high percentage of the respondents of both regions believed that the strategy would not work. In-depth interviews with a 70 year old farmer indicate that adopting this strategy may cause farmers a low economic return. Experiences gathered over the years enable farmers to detect when soil erosion had taken place. Most utilized indigenous techniques like mulching and contouring. Over time these have evolved into mechanized and technologically advanced techniques like the use of heavy machinery to plow the land, however as explained below this has proven to be quite an expensive venture:

“When we were younger, we were not required to do much... It was tedious then, because we used to some farm animals for the soil instead of the machines. But now the ground is harder so we have to advance and use machines for ploughing and harvesting however it is expensive. Last year, most farms did not have a lot of harvest because of the weather conditions. Those who had the machines did better but some of them also run into heavy losses because their investment into the machines was high but the returns quite low” (70 year old male farmer, Akorley).

The statement from the farmer above explains why the strategy is an expensive one. Farmers who invest heavily into the machinery may do much better than farmers who adopt the use of machinery. However, they are prone to heavier losses when they have lower returns on their investments. As noted by studies like Sherka (2023) and Turyahabwe et al. (2022) reiterates that some farmers may not adopt this strategy due to poor returns of investment. Further analysis of the data shows that 33.47% of respondents stated that they did not adopt the strategy due to the lack of information. Studies like Belayneh (2023), shows that farmers with access to information like Climate SMART programmes, training programs by extension officers as well as some level of education are more likely to adopt the strategy. In this study, farmers who stated lack of information may have inadequate or a lack of access to the right source of information. Though

some farmers may rely on indigenous knowledge to take steps against efficient soil erosion, this may prove inefficient especially for large farms. The data also reveals that when compared to men, a larger percentage of women did not adopt the strategy, due to lack of information. This may be because of the labour intensive nature of rural women's time in between household chores, farm work and attending training programmes (Turyahabwe et al., 2022).

The study also shows 15.75% of respondents stated lack of finance as a reason for not adopting the strategy. According to the FAO (2023), modern soil conservation techniques are capital intensive. Farmers without good financial resources are more likely to not adopt the strategy. However, women are more likely to experience this as is seen in Table 5.6b. This is because majority of women experience economic constraints, due to restrictions in land ownership rights, which causes many rural female farmers unable to secure loans due to the lack of collateral.

Effectiveness of preventing soil erosion

Table 5.6c shows results from respondents who were asked if the strategy worked.

Table 5.6c: did the strategy work

Variables	Yes	No	Total
	N (%)	N (%)	N (%)
All	128 (92.8)	10 (7.2)	138 (100)
Yilo Krobo	38 (95)	2 (5)	40 (100)
Huhunya	10 (83.3)	2 (16.7)	12 (100)
Obawale	4 (100)	0 (0)	4 (100)
Akorley	24 (100)	0 (0)	24 (100)
Wa West	90 (91.8)	8 (8.2)	98 (100)
Siiru	46 (95.8)	2 (4.2)	48 (100)
Dabo	22 (100)	0 (0)	22 (100)

Siriyiri	22 (78.6)	6 (21.4)	28 (100)
Gender			
Male	72 (91.1)	7 (8.9)	79 (100)
Female	56 (94.9)	3 (5.1)	59 (100)
Total	128 (92.8)	10 (7.2)	138 (100)

Source: Fieldwork, 2022

The above shows that across districts significantly a large percentage of respondents agreed that the strategy worked. When spatially differentiated by districts, 95% of the respondents in Yilo Krobo agreed that the strategy worked. This is in contrast to 91.8% of the respondents in Wa West who were of the view that the strategy worked.

In relation to gender, a rather higher percentage of women and men agreed that the strategy worked, although data showed that fewer women than men adopted the strategy (See Table 5.6c). A high percentage of women who adopted the strategy stated that it worked. This shows that when the required structure is are put in place such as effective government policies which would promote land ownership among women. The strategy is likely to be adopted by more female farmers.

5.7 Start to produce handicraft

Some effects of climate variations have led to a decline in crop yields. This results in a reduction in food production and in some instances, a reduction in farmers' income. In order to cope with such effects, some farmers adopt ways to diversify their income (Amfo & Ali, 2020). Some farmers start to produce handicraft such as beads, calabash making, basket weaving in order to supplement income or to gain money to buy additional farm inputs (Tabbo et al., 2016).

Table 5.7a: Adoption of handicraft production

	Male		Female		All	
	Adopted	Not adopted	Adopted	Not adopted	Adopted	Not adopted
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
All	15 (6.2)	228 (93.8)	17 (7.5)	209 (92.5)	32 (6.8)	437 (93.2)
Yilo Krobo	10 (8.3)	111 (91.7)	5 (4.6)	104 (95.4)	15 (6.5)	215 (93.5)
Huhunya	5 (11.4)	39 (88.6)	3 (7.9)	35 (92.1)	8 (9.8)	74 (90.2)
Obawale	2 (6.5)	29 (93.5)	1 (3.3)	29 (96.7)	3 (4.9)	58 (95.1)
Akorley	3 (6.5)	43 (93.5)	1 (2.4)	40 (97.6)	4 (4.6)	83 (95.4)
Wa West	5 (4.1)	117 (95.9)	12 (10.3)	105 (89.7)	17 (7.1)	222 (92.9)
Siiru	1 (2.9)	33 (97.1)	4 (11.1)	32 (88.9)	5 (7.1)	65 (92.9)
Dabo	0 (0)	41 (100)	5 (12.5)	35 (87.5)	5 (6.2)	76 (93.8)
Siriyiri	4 (8.5)	43 (91.5)	3 (7.3)	38 (92.7)	7 (8)	81 (92)
P-values (District)	$\chi^2 = 1.8205$ Pr = 0.177		$\chi^2 = 2.6072$ Pr = 0.106		$\chi^2 = 0.0644$ Pr = 0.800	
P-values (community)	$\chi^2 = 5.8147$ Pr = 0.325		$\chi^2 = 4.3811$ Pr = 0.496		$\chi^2 = 2.3778$ Pr = 0.795	

Source: Fieldwork, 2022

Table 5.7a shows that across the two regions, a significantly low percentage of respondents adopted the strategy. This was surprising because the researcher believed that this would have served as another source of income based on some literature works like (Olwig & Gough, 2013; Rodima et al., 2012).

When differentiated by districts, a significantly low percentage of respondents in Yilo Krobo, adopted the strategy and also in Wa West, where 7.1% of respondents adopted the strategy. In relation to gender, a significantly higher percentage of male farmers in Yilo Krobo adopted the strategy as compared to 4.6% of females who adopted it. In Wa West, a significantly low percentage of men adopted the strategy as compared to 10.3% of women who adopted. The reason for this disparity is probably due to the deeply entrenched patriarchal norms in the Northern

Savannah Zone which considers some jobs like basket weaving, the making of beads and other decoration artifacts as a job for women. A farmer had this to say:

“My wife sometimes weaves baskets and beads. But I will not join her... yes the crops are not yielding the way it should but I can’t join her. My friends would laugh. You see those things are not for men making beads and baskets...it is true that some men do that but I personally will not...”

(53 year old male farmer, Siriryiri).

Respondents who did not adopt the strategy were interrogated on why they did not adopt the strategy. Results are shown in Table 7.7b below.

Reasons why strategy was not adopted

Table 5.7b: Reason for not adopting handicrafts production

	Yilo Krobo			Wa West			All		
	Male	Female	All	Male	Female	All	Male	Female	All
	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)
Lack of finance	1 (0.97)	11 (11)	12 (5.91)	48 (44.86)	59 (60.82)	107 (52.45)	49 (23.33)	70 (35.53)	119 (29.24)
Lack of information	13 (12.62)	24 (24)	37 (18.23)	43 (40.19)	47 (48.45)	90 (44.12)	56 (26.67)	71 (36.04)	127 (31.2)
It would not help	76 (73.79)	62 (62)	138 (67.98)	43 (40.19)	29 (29.9)	72 (35.29)	119 (56.67)	91 (46.19)	210 (51.6)
Other reason	24 (23.3)	23 (23)	47 (23.15)	13 (12.15)	13 (13.4)	26 (12.75)	37 (17.62)	36 (18.27)	73 (17.94)
Total valid cases	103 (110.68)	100 (120)	203 (115.27)	107 (137.38)	97 (152.58)	204 (144.61)	210 (124.29)	197 (136.04)	407 (129.98)
P-values	$\chi^2 = 17.3207$ Pr = 0.044			$\chi^2 = 13.1632$ Pr = 0.283			$\chi^2 = 15.0797$ Pr = 0.179		

Source: Fieldwork, 2022.

From data analysis, it was determined that a large percentage of respondents believed that the strategy would not work for them. This was followed by 33.47% who stated lack of information and 15.51% who stated lack of finance. This is in line with the findings of Bawakyillenuo et al.

(2016) which stipulate that most farmers who face financial and information flow constraints are not likely to adopt a strategy. Further analysis shows that when spatially differentiated, 60.96% of the respondents in Yilo Krobo believed that the strategy would not help, followed by 15.78% and 14.38% of the respondents who stated lack of finance and lack of information.

In relation to gender, 73.79% of male respondents in the Yilo Krobo district stated that the strategy would not help as compared to 62% female respondents who stated the same. On the other hand, in Wa West a high percentage of women as compared to men stated lack of finance as the reason the strategy would not work. Interestingly, a closer analysis of the data shows that a comparatively larger percentage of male respondents in Wa West as compared to those in the Yilo Krobo district stated that the lack of information and information was responsible for their not adopting the strategy. This was the same for women. This highlights the importance of good information flow and finances in building the adaptive capacity of farmers. Inadequate or insufficient information flow has the potential of hindering and limiting the adaptation options for fasting. Regardless of this, the differences do not have any statistical differences.

Effectiveness of handicraft production

Table 5.7c did the strategy work

Variables	Yes	No	Total
	N (%)	N (%)	N (%)
All	29 (90.6)	3 (9.4)	32 (100)
Yilo Krobo	14 (93.3)	1 (6.7)	15 (100)
Huhunya	7 (87.5)	1 (12.5)	8 (100)
Obawale	3 (100)	0 (0)	3 (100)
Akorley	4 (100)	0 (0)	4 (100)
Wa West	15 (88.2)	2 (11.8)	17 (100)
Siiru	5 (100)	0 (0)	5 (100)
Dabo	5 (100)	0 (0)	5 (100)
Siriyiri	5 (71.4)	2 (28.6)	7 (100)
Gender			
Male	13 (86.7)	2 (13.3)	15 (100)

Female	16 (94.1)	1 (5.9)	17 (100)
Total	29 (90.6)	3 (9.4)	32 (100)

Source: Fieldwork, 2022

Table 5.7c shows that across regions, 90.6% of the respondents agreed that the strategy worked. That is, it generated income thereby diversifying the livelihoods of those who adopted it. When spatially differentiated by district, 93.3% of the respondents in the Yilo Krobo district agreed the strategy worked. This is in contrast with 88.12% of respondents in Wa West who believed same. This was of particular surprise to the researcher since earlier findings (Olwig & Gough, 2013) seem to suggest the prevalence of handicraft production in the Wa West district and how it served as a form of livelihoods for off-farm activities. However, as the researcher noted, most respondents from the Wa West district mentioned that access to capital and to the target market was on the decline. Though the respondents in the Wa West district have a history of handicraft production, some farmers believe that contemporary times reflect a reduction in the target market. As one interviewee lamented:

“At first the people in the city would come for can chairs, and hats. They go and sell it in their big shops. But I hear that now they can go to China and produce the same thing. But it’s not the same this is our culture. They don’t understand that. Nowadays it’s only the tourists who come here. And as you can see there is none around because of the Covid restrictions” (56 year old female Farmer, Siiru)

Consequently, communities in Yilo Krobo, all respondents in Obaawale and Akorley believed that the strategy worked whereby 87.5% of respondents in Huhunya believed that the strategy worked. In Wa West, the Siiru and Dabo communities had all respondents agreeing that the strategy worked followed by 71.4% of respondents in Siriyiri.

5.8 Look for non-agricultural work

Most farmers are reliant on rain-fed agriculture (Fagariba et al., 2018). The unpredictability of weather patterns results in poor crop yields which makes most farmers susceptible to high food insecurity and more vulnerable to poverty. In order to adapt to climate change, some farmers choose to diversify their livelihoods by engaging in non-agricultural work such as petty trading, building construction and in some cases mining. In **Table 5.8a**, it can be seen that across regions less than 50% of farmers adopted the strategy.

Table 5.8a: Look for non-agricultural work

	Male		Female		All	
	Adopted	Not adopted	Adopted	Not adopted	Adopted	Not adopted
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
All	115 (47.3)	128 (52.7)	114 (50.4)	112 (49.6)	229 (48.8)	240 (51.2)
Yilo Krobo	47 (38.8)	74 (61.2)	50 (45.9)	59 (54.1)	97 (42.2)	133 (57.8)
Huhunya	16 (36.4)	28 (63.6)	20 (52.6)	18 (47.4)	36 (43.9)	46 (56.1)
Obawale	11 (35.5)	20 (64.5)	10 (33.3)	20 (66.7)	21 (34.4)	40 (65.6)
Akorley	20 (43.5)	26 (56.5)	20 (48.8)	21 (51.2)	40 (46)	47 (54)
Wa West	68 (55.7)	54 (44.3)	64 (54.7)	53 (45.3)	132 (55.2)	107 (44.8)
Siiru	15 (44.1)	19 (55.9)	18 (50)	18 (50)	33 (47.1)	37 (52.9)
Dabo	21 (51.2)	20 (48.8)	25 (62.5)	15 (37.5)	46 (56.8)	35 (43.2)
Siriyiri	32 (68.1)	15 (31.9)	21 (51.2)	20 (48.8)	53 (60.2)	35 (39.8)
P-values (District)	$\chi^2 = 6.9558$ Pr = 0.008		$\chi^2 = 1.7597$ Pr = 0.185		$\chi^2 = 7.9962$ Pr = 0.005	
P-values (community)	$\chi^2 = 12.6529$ Pr = 0.027		$\chi^2 = 5.9701$ Pr = 0.309		$\chi^2 = 12.8541$ Pr = 0.025	

Source: Fieldwork, 2022

When spatially differentiated by districts, 42.2% of the respondents in Yilo Krobo adopted the strategy as compared to 55.2% of the respondents in Wa West. A possible reason that will account for the high percentage of respondents adopting the strategy in Wa West is that, the Wa West district is exposed to above average levels of hunger and food poverty (Zereyesus et al., 2017).

Hence, it can be assumed that there is a pertinent need among farmers from the Wa West district to adopt the strategy when there is a decline in crop yields.

Considering gender, across regions 38.8% of men and 45.9% of women adopted the strategy. This finding was not surprising, as most studies such as those conducted in East Africa and South Asia suggest that most women often times engage in off farms jobs in order to cope with climate change (Aryal et al., 2021). Since most women are primarily caregivers, engaging in non-agriculture works is instrumental in supplementing household income as well as food. However, engaging in this strategy was often limited due to social and cultural issues, which do not permit them to engage in off-farm jobs. For instance, during a reconnaissance survey in the Wa West district, female farmers admitted that because of the erratic rainfall patterns and high temperatures, produce from their vegetable farms were neither good enough for sales nor consumption. To supplement this, they had to engage in petty trade to make some money. This was however, not a sustainable income, since they had to simultaneously take care of their homes.

Some women were also prevented from engaging in it, attributable to the envy of their husband's jealousy. Others also did not have adequate capital to set up a small trade. Despite this, some women had found a way about this problem by sending their children to sell some items after school hours. In doing this, they could fully perform their household duties whilst earning money from their children. A female farmer had this to say in Dabo focus Group Discussion:

“Our husbands are very jealous. If you step out to sell soap, he starts accusing you cheating or that you are wasting time gossiping instead of selling or cooking” (Dabo female Focus group discussion)

A fellow respondent had this to say:

“Yes, it’s true they are jealous. So, I send our eldest son to go round to sell some things before it gets late. It helps with money. But I’m hoping to get a bit of capital then I set up a table top business, so I can even cook there whilst so I don’t stop household duties whilst selling” (Dabo female focus group discussion).

Table 5.8b shows the response of farmers who stated why they did not adopt the strategy.

Reasons for not adopting strategy

Table 5.8b: Reasons for not adopting non-agricultural work

	Yilo Krobo			Wa West			All		
	Male	Female	All	Male	Female	All	Male	Female	All
	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)
Lack of finance	0 (0)	7 (12.28)	7 (5.43)	29 (58)	34 (68)	63 (63)	29 (23.77)	41 (38.32)	70 (30.57)
Lack of information	6 (8.33)	5 (8.77)	11 (8.53)	14 (28)	10 (20)	24 (24)	20 (16.39)	15 (14.02)	35 (15.28)
It would not help	59 (81.94)	43 (75.44)	102 (79.07)	14 (28)	14 (28)	28 (28)	73 (59.84)	57 (53.27)	130 (56.77)
The land is not owned by us	1 (1.39)	0 (0)	1 (0.78)	-	-	-	1 (0.82)	-	1 (0.44)
Other reason	11 (15.28)	7 (12.28)	18 (13.95)	8 (16)	6 (12)	14 (14)	19 (15.57)	13 (12.15)	32 (13.97)
Total valid cases	72 (106.94)	57 (108.77)	129 (107.75)	50 (130)	50 (128)	100 (129)	122 (116.39)	107 (117.76)	229 (117.03)
P-values	$\chi^2 = 14.5036$ Pr = 0.106			$\chi^2 = 9.7483$ Pr = 0.371			$\chi^2 = 19.3476$ Pr = 0.080		

Source: Fieldwork, 2022.

Across regions, 56.77% of the respondents stated that the strategy would not work. This was contrary to what has been established in the Hellin and Fisher (2019), which suggests that off-farm

work participation can significantly reduce vulnerability to poverty. Codjoe and Owusu (2011), equally assert that income from non-agricultural activities aid in poverty reduction as well as enhance household consumption. However, Mathenge and Tschirley (2015) show that rural households in Ethiopia had expressed how non-agricultural work had a negative impact on labour. Hence, there was poor crop yield and lesser application of fertilizer due to farmers engaging in other forms of works.

On grounds of gender, a significantly high percentage of both men and women in Yilo Krobo stated that the strategy would not help; this followed by 15.8% males and 12.28% females who stated that there were other reasons why they did not adopt the strategy such as how permanent it will be. A female farmer stated the following:

“There have been a few NGOs that have been established here. I acted as a clerk/cleaner. The pay was good but they kept shutting down. I don’t know why. It is quite discouraging but they set up and they go off” (Female respondent Siiru).

Despite the differences in respondents’ answers, p values indicate that there is no significant statistical difference between the genders in each district. Respondents who adopted the strategy were later asked whether the strategy worked. This is shown in **Table 5.8c**.



*Effectiveness of non-agricultural work***Table 5.8c: did the strategy (non-agricultural work) work**

Variables	Yes	No	Total
	N (%)	N (%)	N (%)
All	191 (83.4)	38 (16.6)	229 (100)
Yilo Krobo	71 (73.2)	26 (26.8)	97 (100)
Huhunya	25 (69.4)	11 (30.6)	36 (100)
Obawale	13 (61.9)	8 (38.1)	21 (100)
Akorley	33 (82.5)	7 (17.5)	40 (100)
Wa West	120 (90.9)	12 (9.1)	132 (100)
Siiru	32 (97)	1 (3)	33 (100)
Dabo	39 (84.8)	7 (15.2)	46 (100)
Siriyiri	49 (92.5)	4 (7.5)	53 (100)
Gender			
Male	93 (80.9)	22 (19.1)	115 (100)
Female	98 (86)	16 (14)	114 (100)
Total	191 (83.4)	38 (16.6)	229 (100)

Source: Fieldwork, 2022

Across regions, 83.4% of the respondents believed that the strategy worked. When spatially differentiated by districts, 73.2% of the respondents in Yilo Krobo believed that the strategy worked as compared to 90.9% of the respondents in Wa West. Among the communities in the Yilo Krobo district, 82.5% of respondents in Akorley stated that the strategy worked, followed by 69.4% of respondents in Huhunya and 61.9% of respondents in Obawale. In Wa West, 97% of respondents in Siiru adopted the strategy, followed by 92.5% of Siriyiri and 84.8% of Dabo.

In relation to gender, 86% of females agreed that the strategy worked as compared to 80.9% of males. Despite the concerns raised by women during field interviews, a larger percentage of

women who adopted the strategy stated that it worked. The researcher had expected that, house care obligations will tear women away from the strategy; thus, not reaping the benefits associated with the strategy. Nonetheless, the findings suggested otherwise.

5.9 Changes in planting time

As part of the planned adaptation practices, the government of Ghana through the Ministry of Agriculture, has introduced improved varieties crops such as the early maturing white maize. This is considered as part of modern tillage practices. However, according to (Bawakyillenuo et al., 2016), adaptation to a traditional tillage practice like change in planting time is one of the common means some farmers adapt to changes in the climate. This is because it is relatively cheaper than purchasing newly improved seedlings. In this study, across regions, a large percentage of respondents had adopted the strategy. A farmer in Akorley stated:

“Some of us delay the time we plant our crops. We no longer plant our crop according to the time we used in the past. Now, we prepare the land and wait for the rains to start. When we get a heavy down pour, then we divide the prepared piece of land into two and plant one part. We plant the other half at a later date so that if drought occurs, only half of the farm would be affected. If the part we planted earlier falls, the later may not fail us and vice versa. If we are fortunate, we get good yield from both parts” (Respondent Youth FGD, Akorley)

In **Table 5.9a**, as seen below, there were not many differences in the adoption patterns among the communities understudy in each district.

Table 5.9a: Adoption of Changes in Planting Time

	Male		Female		All	
	Adopted	Not adopted	Adopted	Not adopted	Adopted	Not adopted
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
All	210 (86.4)	33 (13.6)	190 (84.1)	36 (15.9)	400 (85.3)	69 (14.7)
Yilo Krobo	113 (93.4)	8 (6.6)	103 (94.5)	6 (5.5)	216 (93.9)	14 (6.1)
Huhunya	42 (95.5)	2 (4.5)	38 (100)	0 (0)	80 (97.6)	2 (2.4)
Obawale	31 (100)	0 (0)	29 (96.7)	1 (3.3)	60 (98.4)	1 (1.6)
Akorley	40 (87)	6 (13)	36 (87.8)	5 (12.2)	76 (87.4)	11 (12.6)
Wa West	97 (79.5)	25 (20.5)	87 (74.4)	30 (25.6)	184 (77)	55 (23)
Siiru	29 (85.3)	5 (14.7)	35 (97.2)	1 (2.8)	64 (91.4)	6 (8.6)
Dabo	30 (73.2)	11 (26.8)	21 (52.5)	19 (47.5)	51 (63)	30 (37)
Siriyiri	38 (80.9)	9 (19.1)	31 (75.6)	10 (24.4)	69 (78.4)	19 (21.6)
P-values (District)	$\chi^2 = 9.9727$ Pr = 0.002		$\chi^2 = 17.0856$ Pr = 0.000		$\chi^2 = 26.7595$ Pr = 0.000	
P-values (community)	$\chi^2 = 15.3541$ Pr = 0.009		$\chi^2 = 47.7932$ Pr = 0.000		$\chi^2 = 56.0443$ Pr = 0.000	

Source: Fieldwork, 2022

In relation to gender across regions, a slightly higher percentage of men adopted the strategy as compared to women. However, in Yilo Krobo, 94.5% of women adopted the strategy as compared to 93.4% men. This disparity was explained by a respondent below:

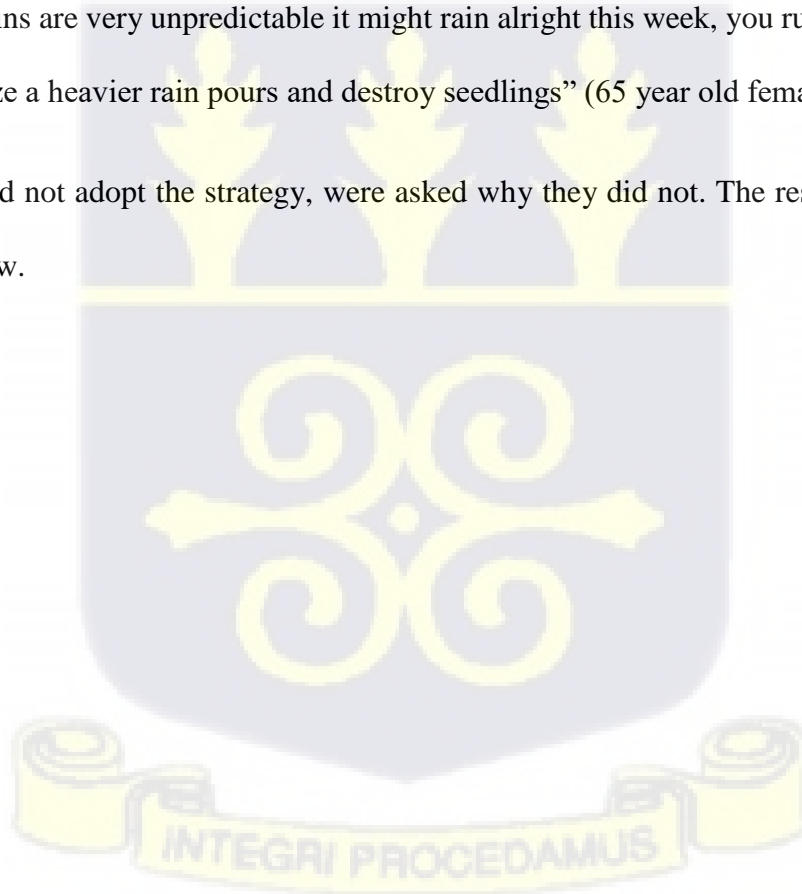
“Oh when it comes to planting the women are very good at it they can easily tell when to plant or when not to. Even though as u can see the rain is not regular the women are very good in guessing the right time. Sometimes, the women in my family plant earlier or later. Though it might not

always work it is sometimes reliable. There are times I even listen to her” (50 year old male farmer from Huhunya).

Perception data from this study shows that, women are more likely to perceive changes in temperature due to traditional gender norms. There again, due to various experiences many rural have over time acquired indigenous knowledge which enabled them to detect when to expect the rains (Orlove & Roncoli, 2010). A 65 year old woman from Dabo noted that:

“Experiences from earlier seasons have taught some of us when to plant and when to wait. Sometimes when it begins to rain you will have to wait for a while to observe the weather, because nowadays the rains are very unpredictable it might rain alright this week, you rush to go and plant before you realize a heavier rain pours and destroy seedlings” (65 year old female farmer, Dabo)

Farmers, who did not adopt the strategy, were asked why they did not. The results are shown in **Table 5.9b** below.



Reasons why strategy was not adopted

Table 5.9b: Reasons why changes of planting time it was not adopted

Reasons for not Adopting	Yilo Krobo			Wa West			All		
	Male	Female	All	Male	Female	All	Male	Female	All
	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)
Lack of finance	-	-	-	7 (29.17)	3 (10)	10 (18.52)	7 (22.58)	3 (8.33)	10 (14.93)
Lack of information	1 (14.29)	3 (50)	4 (30.77)	19 (79.17)	22 (73.33)	41 (75.93)	20 (64.52)	25 (69.44)	45 (67.16)
It would not help	6 (85.71)	2 (33.33)	8 (61.54)	2 (8.33)	7 (23.33)	9 (16.67)	8 (25.81)	9 (25)	17 (25.37)
Other reason	0 (0)	1 (16.67)	1 (7.69)	5 (20.83)	3 (10)	8 (14.81)	5 (16.13)	4 (11.11)	9 (13.43)
Total valid cases	7 (100)	6 (100)	13 (100)	24 (137.5)	30 (116.67)	54 (125.93)	31 (129.03)	36 (113.89)	67 (120.9)
P-values	$\chi^2 = 4.4488$ Pr = 0.108			$\chi^2 = 9.0617$ Pr = 0.170			$\chi^2 = 5.6499$ Pr = 0.464		

Source: Fieldwork, 2022

Further analysis of the field results shows that a high percentage of respondents across regions stated lack of information as a reason why the strategy was not adopted. This is in line with Bawakyillenuo et al. (2016) study on adaptation strategy in Northern Savannah zone. In this work, the authors assert that adequate information enables the spread of knowledge on tillage practices. However, though it has been established that a majority of respondents adopted the strategy, it could be that those farmers had a better advantage of accessing information flow through access agricultural extension officer, experiences from returned migrants as well as continuous experimentations of indigenous knowledge.

Nevertheless, there are some farmers who might have access to information, but might not have the financial capacity to swallow up the risks that are associated with the changing of the planting times. **Table 5.9c** showcases respondents who adopted the strategy and believed that it worked.

Effectiveness of strategy

Table 5.9c: did the strategy (changing of planting time) work?

Variables	Yes	No	Total
	N (%)	N (%)	N (%)
All	330 (82.5)	68 (17)	2 (0.5)
Yilo Krobo	202 (93.5)	14 (6.5)	0 (0)
Huhunya	72 (90)	8 (10)	0 (0)
Obawale	59 (98.3)	1 (1.7)	0 (0)
Akorley	71 (93.4)	5 (6.6)	0 (0)
Wa West	128 (69.6)	54 (29.3)	2 (1.1)
Siiru	37 (57.8)	25 (39.1)	2 (3.1)
Dabo	44 (86.3)	7 (13.7)	0 (0)
Siriyiri	47 (68.1)	22 (31.9)	0 (0)
Gender			
Male	177 (84.3)	33 (15.7)	0 (0)
Female	153 (80.5)	35 (18.4)	2 (1.1)
Total	330 (82.5)	68 (17)	2 (0.5)

Source: Fieldwork

Table 5.9c showcases respondents who adopted the strategy and believed it worked. That is, did the strategy enable them to either minimize crop losses or maintain crop yields? A large section of respondents across regions stated that the strategy worked. Within districts, a larger percentage of farmers in Yilo Krobo as compared to Wa West stated that it worked. Equally, communities understudy in Yilo Krobo reported a high percentage of farmers stating that the strategy works. In relation to gender, surprisingly a larger section of male farmers stated that the strategy worked as

compared to female farmers. This likely because changing of planting times may not be fully effective without incorporating other measures like the use of fertilizers and pesticides. As indicated earlier, most rural female farmers may not readily have access to such measures. This further implies that male farmers who can readily integrate additional farm inputs like fertilizers with changes in planting time will more likely find the strategy more effective

5.10 Reduction of expenses

Sometimes, climatic variations have socio-economic impacts on rural households. For instance, high temperature patterns could cause droughts. This can consequently affect the main economic activities of farmers in the communities. In the case of Ghana, most farming households rely on rain-fed agriculture as earlier pointed out. High temperature and minimal rain lead to crop failures, in some cases, a decrease in crop yield particularly, grain crops and in certain instance, lower livestock production. This further weakens the economic ecosystem of most households. Due to the overall effects, some farmers adopt a much more economical way of running their households. In Udmale et al. (2014) work in India, one of the ways farmers coped with household income decline was to reduce expenses on social activities like festivals and other social gatherings.

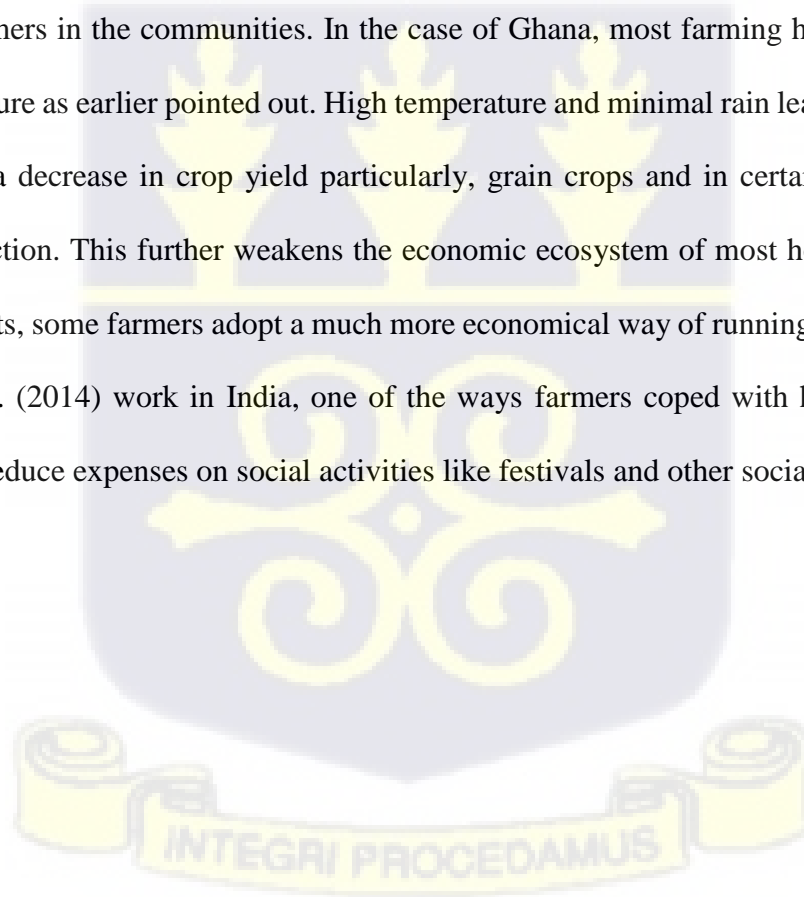


Table 5.10a: Adoption of reduction of expenses

	Male		Female		All	
	Adopted	Not adopted	Adopted	Not adopted	Adopted	Not adopted
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
All	127 (52.3)	116 (47.7)	118 (52.2)	108 (47.8)	245 (52.2)	224 (47.8)
Yilo Krobo	54 (44.6)	67 (55.4)	58 (53.2)	51 (46.8)	112 (48.7)	118 (51.3)
Huhunya	16 (36.4)	28 (63.6)	16 (42.1)	22 (57.9)	32 (39)	50 (61)
Obawale	21 (67.7)	10 (32.3)	25 (83.3)	5 (16.7)	46 (75.4)	15 (24.6)
Akorley	17 (37)	29 (63)	17 (41.5)	24 (58.5)	34 (39.1)	53 (60.9)
Wa West	73 (59.8)	49 (40.2)	60 (51.3)	57 (48.7)	133 (55.6)	106 (44.4)
Siiru	16 (47.1)	18 (52.9)	15 (41.7)	21 (58.3)	31 (44.3)	39 (55.7)
Dabo	24 (58.5)	17 (41.5)	20 (50)	20 (50)	44 (54.3)	37 (45.7)
Siriyiri	33 (70.2)	14 (29.8)	25 (61)	16 (39)	58 (65.9)	30 (34.1)
P-values (District)	$\chi^2 = 5.6316$ Pr = 0.018		$\chi^2 = 0.0842$ Pr = 0.772		$\chi^2 = 2.2710$ Pr = 0.132	
P-values (community)	$\chi^2 = 18.8407$ Pr = 0.002		$\chi^2 = 18.0443$ Pr = 0.003		$\chi^2 = 33.4097$ Pr = 0.000	

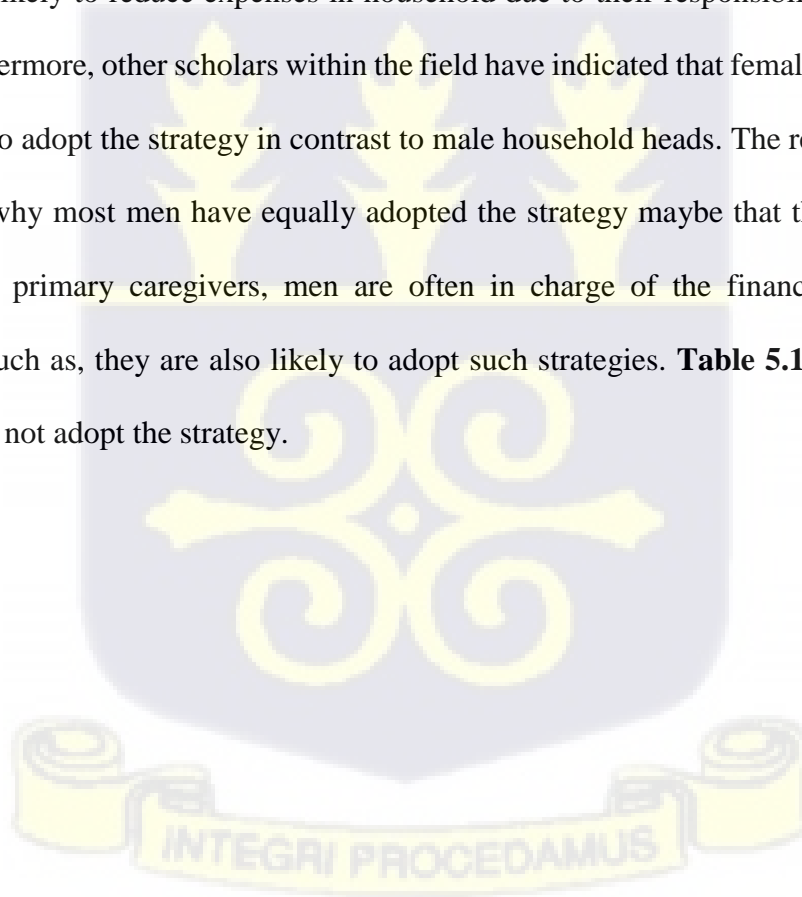
Source: Fieldwork, 2022

In this study as shown in **Table 5.10a**, farmers are reported to have reduced expenditure on social gatherings and household consumptions. For instance, some households fed themselves twice a day instead of the usual three times a day. Households with school going children often relied on the school feeding initiative by the Ghana government through the auspices of the Ministry of Education to cater for the lunch of children during mid-day:

“Maize has been very low this year. But it was worse in the previous year...what I do is that I prepare banku a lot. My husband eats it before going to the farm as for the children I prepare

porridge with corn dough and they have their lunch in school. But they complain the food is not enough. At times I am worried, but what can I do. When things get better, I will add extra money for them” (31 year old female farmer, Huhunya).

Table 5.10a also indicates that over 50% of farmers adopted the strategy across regions. Out of this, a slightly higher percentage in Wa West adopted the strategy as compared to Yilo Krobo. This was expected, since the Wa West district is considered the poorest district in the country. Among genders, both male and female farmers across region equally adopted the strategy with a slight difference of 0.1% percentage. In contrast, the work of Yang et al. (2021) state that women are much more likely to reduce expenses in household due to their responsibility as the primary care giver. Furthermore, other scholars within the field have indicated that female household heads are more likely to adopt the strategy in contrast to male household heads. The researcher assumes that the reason why most men have equally adopted the strategy maybe that though women are traditionally the primary caregivers, men are often in charge of the financial capital of the household. As such as, they are also likely to adopt such strategies. **Table 5.10b** shows reasons why farmers did not adopt the strategy.



Reasons why strategy was not adopted

Table 5.10b: Reasons for not adopting reduction of expenses

Reasons for not Adopting	Yilo Krobo			Wa West			All		
	Male	Female	All	Male	Female	All	Male	Female	All
	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)	N (% of cases)
Lack of finance	4 (6.56)	0 (0)	4 (3.96)	2 (4.26)	5 (9.8)	7 (7.14)	6 (5.56)	5 (5.49)	11 (5.53)
Lack of information	0 (0)	1 (2.5)	1 (0.99)	2 (4.26)	4 (7.84)	6 (6.12)	2 (1.85)	5 (5.49)	7 (3.52)
It would not help	57 (93.44)	36 (90)	93 (92.08)	45 (95.74)	41 (80.39)	86 (87.76)	102 (94.44)	77 (84.62)	179 (89.95)
Other reason	3 (4.92)	4 (10)	7 (6.93)	1 (2.13)	4 (7.84)	5 (5.1)	4 (3.7)	8 (8.79)	12 (6.03)
Total valid cases	61 (104.92)	40 (102.5)	101 (103.96)	47 (106.38)	51 (105.88)	98 (106.12)	108 (105.56)	91 (104.4)	199 (105.03)
P-values	$\chi^2 = 8.0070$ Pr = 0.156			$\chi^2 = 13.1559$ Pr = 0.041			$\chi^2 = 17.1385$ Pr = 0.029		

Source: Fieldwork, 2022

Across regions, 89.95% of respondents stated that the strategy would not work. A reason for such large percentage might be that in as much the aim of the strategy is to reduce and cut down expenditure, it sometimes has unforeseen consequences on mental and physical health. As explained by Udmale et al. (2014) work in India, farmers who opted to reduce expenses in both households and social life like festivals often saw a decline in their mental health as well as a feeling of hopelessness. Others experienced hunger because of the reduction in food consumption.

It was gathered from field interviews that more marital disputes occurred in the households due to the insufficiency of food, others also experienced issues when a spouse used the money for an item considered unnecessary by the other:

“The women do not understand that as men I need to contribute at family meetings. If I spend extra money for the family house renovation it becomes a big argument. Yes, crop yields have been low and the roads are bad so by the time we transport them it is spoilt. The money is not in but that does not mean I should not contribute for the family...what will my family think of me” (Male respondent, Youth FGD Akorley)

A woman however, countered the male’s argument with a varying perspective:

“He doesn’t understand. When the children are hungry who do they go to? You cannot just use the money for renovation. The children are hungry, they are eating twice a day sometimes a day and instead of him to manage he is renovating houses” (female respondent, Youth focus group discussion, Akorley).

When spatially differentiated by districts, a slightly higher percentage of respondents in Wa West adopted the strategy as compared to those in Yilo Krobo. As mentioned in earlier in this work, the Wa West is considered one of the poorest districts in Ghana. It is therefore, likely for them to be hit with much more severely by the socio-economic effects of climate change. The researcher assumes that without any additional supplementary income, there is a possibility that farmers will report that it did not work

Respondents who adopted the strategy were further asked if the strategy worked. **Table 5.10c** also indicates that 66.5% of respondents across regions stated that it worked.

Effectiveness in reduction of expenses

Table 5.10c: did the strategy (reduction of expenses) work?

Variables	Yes	No	Total
	N (%)	N (%)	N (%)
All	163 (66.5)	82 (33.5)	245 (100)
Yilo Krobo	96 (85.7)	16 (14.3)	112 (100)
Huhunya	24 (75)	8 (25)	32 (100)
Obawale	45 (97.8)	1 (2.2)	46 (100)
Akorley	27 (79.4)	7 (20.6)	34 (100)
Wa West	67 (50.4)	66 (49.6)	133 (100)
Siiru	15 (48.4)	16 (51.6)	31 (100)
Dabo	23 (52.3)	21 (47.7)	44 (100)
Siriyiri	29 (50)	29 (50)	58 (100)
Gender			
Male	88 (69.3)	39 (30.7)	127 (100)
Female	75 (63.6)	43 (36.4)	118 (100)
Total	163 (66.5)	82 (33.5)	245 (100)

Source: Fieldwork, 2022

When spatially differentiated by districts, a larger percentage of respondents in Yilo Krobo stated that it worked as compared to 50.4% of respondents in Wa West. As stated earlier, since Wa West is much more vulnerable to poverty due to harsh climate and other socio-economic factors, it would be prudent to not only adopt this strategy, but also, to include other strategies such as off-farm work to cater for their livelihoods. In relation to gender, a slightly higher percentage of male respondents stated that the strategy worked as compared to the female counterparts. This may likely be due to the primary care giver role of most women; hence, the onus of household management lies on them. In addition, due to traditional role assignments, few women can afford to add another strategy to this since it will compromise with household up keep.

Testing of hypothesis

H₀: There is no significant relationship between gender and the adoption of adaptation strategies

Per the chi square test conducted in the above strategies, the p values suggest that there is a significant relationship between gender and the adoption of adaptation strategies, therefore the null test has been rejected and the alternate hypothesis has been accepted.

5.11 Determinants of adaptation strategies using the logistic regression model

The study employed binary logistic regression models to analyse the household survey of 469 farmers. This was thought to be appropriate because each adaptation strategy served as categorical dependent variable with two or more discreet outcomes. Each of the farmers decided whether to adopt or not to adopt a strategy to deal with climate change. Therefore, let the variable A_i represent the farmers' choice to adopt a strategy (e.g., irrigation) and βE_i be a vector of explanatory variables that determine the farmers' decision, such as perception of changes in rainfall, training in CSA, length of stay in the community, age as well as district, and educational level of the farmer. The general model for adopting a strategy is as follows:

$$A_i = \frac{1}{1 + e^{-\beta E_i}}$$

where the farmer's decision is $A_i = 1$ if he adopts a strategy and 0 if he does not. The sampled farmers were considered into different categories. For instance, five age categories of the respondents were used to analyse an adaptation strategy. They are 18-25 years, 26-35, 36-45, 46-55 and 56+. Also, the educational levels of the farmers were grouped into four; no formal education, primary education, JHS education and SHS/tertiary education. Marital status was divided into two, married and not married; and the length of stay in the communities was divided into four; all my life, 20 years or more, 10-19 years, and less than 10 years.

The above model was therefore, used to examine the determinants of the adaptive capacity of the various autonomous adaptation strategies.

Table 5.11: Logistic regression of irrigation, farming less land, changes in planting time, improved new crop varieties

	Adoption of irrigation	Farm less land	Changes in planting time	Improved or new crop varieties
	Odds Ratio (Std. Err.)	Odds ratio (Std. Err.)	Odds Ratio (Std. Err.)	Odds Ratio (Std. Err.)
Gender of respondent				
Female	1	1	1	1
Male	1.29 (0.35)	0.64 (0.15*)	0.86 (0.31)	1.56 (0.34**)
Age of respondent				
18-25	1	1	1	1
26-35	1.02 (0.49)	1.32 (0.54)	0.8 (0.36)	1.42 (0.94)
36-45	0.92 (0.46)	1.8 (0.76)	1.27 (0.57)	2.48 (1.7)
46-55	0.72 (0.42)	2.5 (1.18)*	1.86 (0.94)	1.29 (0.94)
56+	0.69 (0.4)	1.69 (0.87)	1.25 (0.93)	2.63 (1.26**)
Community				
Huhunya	1	1	1	1
Obawale	0.15 (0.10***)	0.1 (0.05***)	0.67 (0.87)	0.47 (0.18*)
Akorley	1.41 (0.56)	0.39 (0.15**)	0.13 (0.11**)	0.93 (0.32)
Siiru	3.74 (1.79***)	1.39 (0.62)	0.02 (0.02***)	1.65 (0.72)
Dabo	0.85 (0.42)	0.98 (0.41)	0.01 (0.01***)	1.34 (0.54)
Siriyiri	0.17 (0.10***)	2.18 (0.90*)	0.02 (0.02***)	2.19 (0.89*)
Educational level of respondent				
No formal education	1	1	1	1
Primary	0.69 (0.27)	2.28 (0.82**)	1.34 (0.74)	1.78 (0.61*)
SHS_tertiary	1.15 (0.53)	2.41 (0.97**)	3.31 (2.31*)	2.3 (0.87**)
Marital status				
Married	1.34 (0.42)	0.63 (0.17*)	0.84 (0.37)	1.17 (0.29)
Number of years lived in community				
All my life	1	1	1	1
10 to 19 years	0.51 (0.21)	1.04 (0.36)	1.03 (0.55)	1.84 (0.61*)
less than 10 years	0.34 (0.16**)	1.59 (0.59)	1.49 (0.94)	0.68 (0.24)

Amount of rainfall in community				
Not decreasing	1	1	1	1
Decreasing rainfall	0.97 (0.29)	2.64 (0.67***)	7.84 (3.35***)	0.84 (0.2)
Distribution of rainfall				
Not regular	1	1	1	1
Regular rainfall	1.1 (0.39)	0.61 (0.19)	0.24 (0.12***)	0.65 (0.19)
Training on climate smart agriculture				
None		1	1	1
Received training	1.52 (0.43)	1.98 (0.48***)	1.76 (0.71)	1.7 (0.39**)
R ²	0.1774	0.1930	0.3429,	0.0880
P	0.000	0.0000	0.0000	0.0001

The significance levels are indicated by *, with *** representing a 10% level of significance (p-ratio between 0.05 and 0.1), ** denoting a 5% level of significance (p-ratio less than 0.05 but greater than or equal to 0.01), and * denoting a 1% level of significance (p-ratio less than 0.01). The Pseudo R2 indicates how well the independent variables explain the dependent variable, with higher values preferred over lower ones.

Source: Fieldwork, 2022

5.12 Determinants of Irrigation

The results of the logistic regression on **Table 5.11** show that the main determinants of the adoption of irrigation strategies were village of residence and years lived in the community. When other factors are controlled, farmers from Siiru were about 4 times more likely to adopt irrigation as an adaptive strategy compared to those from Huhunya (the reference category). The relatively high proportion of farmers adopting irrigation at Siiru can be explained by the availability of dams, a driver of this strategy which is lacking in Yilo Krobo. In certain instances, communities in the Wa West are likely to receive help from the government and NGOs as compared to communities in Yilo Krobo (Men FGD Huhunya, 2022). Surprisingly, though Dabo had a dam, it did not appear to have any significant relationship to the adoption of irrigation. This is likely because of some concerns pertaining to the viability of the soil surrounding the dam:

“The soil around the dam is not good for our crops. It is very bad. Some of the materials in the construction of the dam has polluted the earth. There is low fertility and sometimes it smells” (78 year old, male farmer, Dabo).

On the other hand, the likelihood of adopting irrigation as a climate change adaptation strategy decreases among farmers in Obawale than those from Huhunya. For example, respondents in Obawale were 7 times less likely to adopt irrigation as a strategy compared to respondent from Huhunya. The low level of adoption might be due to economic concerns raised during the field interviews. Most farmers had stated a lack of government funding as well as personal financial constraints as reasons why they did not adopt the strategy:

“Money that is the issue. The government doesn’t help. Not even a polytank. Where do they expect me to get the money from? The pumps are expensive, fuel prices are going up. Fertilizers and pesticides are expensive so there is actually no way to invest in irrigation” (Farmer, Obawale).

In addition, farmers from Siriyiri, were about 6 times less likely to adopt irrigation as a strategy compared to those in Huhunya. This observation might be attributable to the poor rehabilitation of dams. Hence, though there was an irrigation facility available, poor maintenance had affected its utility. The logistic regression table further shows that the length of stay in the community had a significant determinant on the adoption of the strategy that the farmers chose. Farmers who had stayed in the community for less than 10 years were 3 times less likely to adopt the strategy as compared to those who stayed in the community all their lives. This, I assume might likely be as a result of privilege. Farmers who had stayed longer in the community were more likely to have access to traditional authorities who will grant them better access to irrigated fields as compared to more recent arrivals.

Thus, the uneven distribution of the adoption of the strategy was determined by economic structures, privilege access to traditional authorities, soil fertility as well as community wide infrastructure. Hence, a community such as Siiru with fertile soil as well as irrigation facility is much more likely to adopt the strategy than communities such as Obawale and Huhunya in the Yilo Krobo district. It is of importance to point out, that, within the Yilo Krobo district, there are also disparities in the distribution of resources that determine the adoption of irrigation such as poor dam maintenance in Siriyiri and poor soil in Dabo.

5.13 Determinants of adoption of less farmland

As pointed out in **Table 5.11**, the adoption of less farmland was one that was quite popular among respondents in both regions. From the logistic regression, it can be noted that gender, community, level of education, marital status, perception of climate change as well as training on climate smart agriculture determined the adoption of the strategy by farmers. The survey revealed that men were twice less likely to adopt the strategy as compared to women (which was the reference category). This was in line with studies like Ilori and Adebayo (2019) which indicates that due to land tenure systems as well as inheritance laws men were more likely to have access to land. As a result, of this, men could have multiple uses of land like renting a part of it in order to offset production cost of their farms. However, women with less access to land as well as smaller land sizes may have to adopt owning lesser farmlands when faced with the effects of climate change in order to reduce farming costs like labour. Additionally, men who marry into their community are more likely own farmlands.

Regarding the communities, farmers in Siriyiri in the Upper West were 2 times more likely to adopt the strategy as compared to Obawale and Akorley in the Yilo Krobo district who were almost

as likely and 3 times less likely to adopt the strategy. Further analysis showed that the adoption of the strategy was also determined by the level of education. The regression determined that, farmers with primary and SHS level education were twice as likely to adopt lesser farmlands. This may likely be because of some form of education that enlightened farmers on the importance of the strategy. On marital status, married farmers are less likely to adopt the strategy as compared to those married. A reason for this is likely due to the fact that, most married farmers would have to share access to the land. Hence, any decision needs to be agreed upon by the spouse. Meanwhile, other farmers' adaptive capacity was influenced by their perception of climate change. The data showed that adoption of the strategy was 3 times more likely to be determined by farmers who perceived a decrease in rainfall. This was not surprising, because a reduction in rainfall presupposes a reduction in crop yields hence, management of larger farmland would mean running at a loss. It suggests that farmers are more likely to adopt the strategy due to understanding that there is a reduction in rainfall, prompting farmers to take tentative measures to avoid the negative effects. Again, farmers who had received training climate smart agriculture were 2 times more likely to adopt the strategy. This is due to an exposure and a better understanding of land management and land use strategies such as proper management between growing crops and grazing on the land (Scherr et al., 2012).

5.14 Determinants in Changes in planting time

Changes in planting time have been used over the years as an indigenous way to cope with climate variability (Bawakyillenuo et al., 2016). In this case, it could be early or late planting times. The late rains have required farmers to cause a change in the farming calendar. Some farmers with higher financial capacity are more likely to adopt new or improved crop varieties. However, those who are poor and unable to procure new seedlings lose their crops to early planting. Hence, many

follow the changes in the planting time strictly, and see that to be beneficial. As revealed by a farmer:

“...the women in my family help with predicting the planting times. It is mostly accurate. On instances where it is not. That means that the farm will run at a loss” (23 year old male Farmer Huhunya).

Despite the proportionally high number of farmers adopting the strategy, there were certain degrees in variations in the adoption of the strategy. The factors that determined the capacity of farmers to adopt the strategy were community of stay of the farmers, level of education, as well as the farmers' perception on rainfall. Farmers in all three communities in the Wa West district were significantly less likely to adopt the strategy as compared to Huhunya (The reference category). Correspondingly, farmers with and SHS or tertiary level of education are 3 times more likely to adopt the strategy as compared to those with no formal education. As expected, farmers who perceived a decrease in rainfall were 8 times more likely to adopt the strategy as compared to farmers who perceived regularity in rainfall, and who were 4 times less likely to adopt the strategy.

5.15 Determinants of adopting improved or new crop varieties

Table 5.11 shows that, the propensity to adopt improved or new crop varieties is determined by a number of factors such as gender, age, community of farmers, level of education, and length of stay in the community as well as a farmer trained climate smart agriculture. Male farmers are twice as likely to adopt the strategy as compared to female farmers. This was not surprising since it had been established earlier that most women did not adopt the strategy because of either financial constraints or inability to access facilities as compared to their male counterparts. In reference to age, the data revealed that older farmers (that is, those between the age groups 46-55 and 56+

years) were more likely to adopt the strategy as compared to the younger farmers. This is probably because the older farmers have much more experiences and thus, have the willingness to adopt the strategy. It is equally probable that due to their experiences, they believe in the validity of the strategy. Again, farmers in Siriyiri were twice more likely to adopt the strategy as compared to farmers in Obawale were twice less likely to adopt the strategy. As mentioned in earlier sections, most farmers in the Yilo Krobo district had stated a huge disparity in the distribution of resources to adapt effectively to climate change. Hence, most farmers in the Northern zone had access to government funded climate change adaptation strategies such financial institutions as well as subsidies on new or improved crop varieties. Though the community of stay of the farmers shows a weaker level of significance, it displays how spatial disparity in resource distribution could affect farmers' adaptation strategies. For instance, farmers from all three communities in the Wa West district were more likely to adopt the strategy as compared to farmers from communities in the Yilo Krobo

In regards to education, farmers with SHS/tertiary and primary education were twice as likely to adopt the strategy. This could be explained by assuming that farmers with higher level of education were likely to appreciate the importance of the strategy as well as acquire the necessary skills to adapt the strategy.

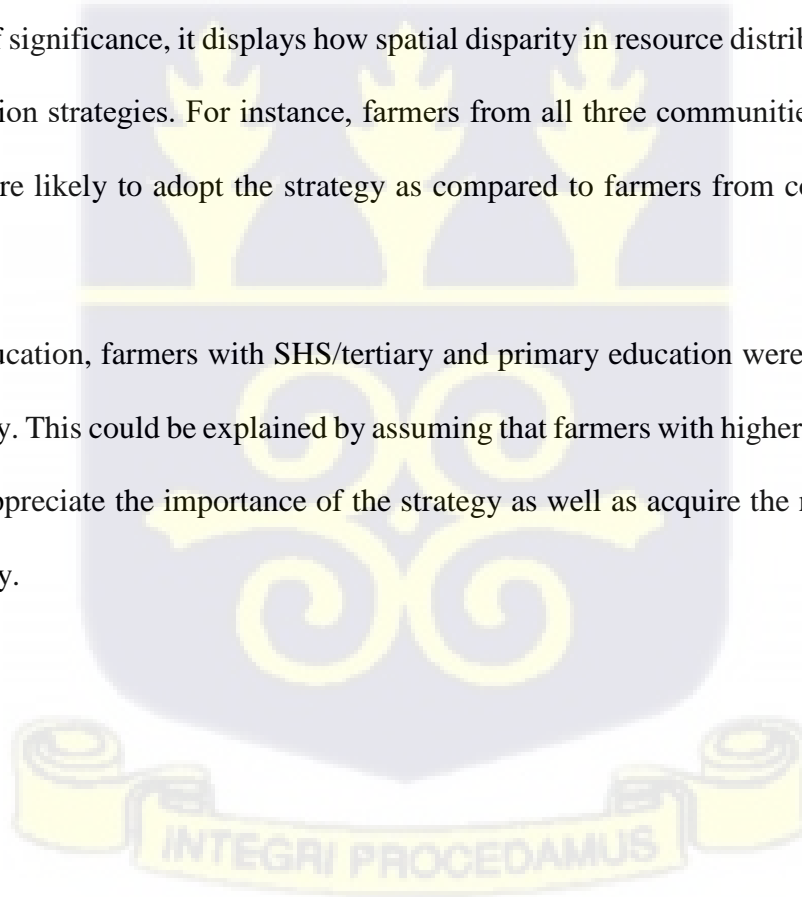


Table 5.12: Logistic regression on the use of pesticides and fertilizers, use of more machinery, steps against soil erosion, production of handicrafts

	Usage of more pesticides and fertilizers	Use more machinery	Take steps against soil erosion	Production of handicrafts
Variables	Odds Ratio (Std. Err.)	Odds Ratio (Std. Err.)	Odds Ratio (Std. Err.)	Odds Ratio (Std. Err.)
<i>Gender of respondent</i>				
Female	1		1	1
Male	2.8 (0.68***)	1.48 (0.4)	1.36 (0.35)	0.7 (0.29)
<i>Age of respondent</i>				
18 – 25	1	1	1	1
26-35	0.93 (0.41)	0.7 (0.33)	1.15 (0.53)	4.94 (5.37)
36-45	0.98 (0.44)	0.58 (0.28)	0.279 (0.38)	1.51 (1.76)
46 – 55	0.7 (0.35)	0.17 (0.10***)	1.54 (0.83)	4.37 (5.16)
56+	0.95 (0.49)	0.36 (0.21*)	1.2 (0.66)	3.96 (4.73)
<i>Community</i>				
Huhunya	1	1	1	1
Obawale	0.3 (0.12***)	0.51 (0.61)	0.47 (0.3)	0.47 (0.37)
Akorley	0.64 (0.23)	14.93 (9.75***)	2.34 (1.03*)	0.59 (0.41)
Siiru	2.6 (1.43*)	95.73 (70.87***)	35.57 (19.30***)	0.57 (0.46)
Dabo	0.32 (0.13***)	12.67 (8.89***)	3.58 (1.82**)	0.74 (0.58)
Siriyiri	1.16 (0.51)	42.08 (28.71***)	5.49 (2.71***)	0.83 (0.62)
<i>Educational level of respondent</i>				
No formal education	1	1	1	1
Primary	0.72 (0.27)	0.43 (0.17**)	1.6 (0.6)	0.35 (0.29)
JHS	0.44 (0.14**)	0.35 (0.15***)	1.75 (0.63)	1 (0.6)
SHS_tertiary	0.61 (0.25)	0.58 (0.25)	2.15 (0.90*)	1.42 (0.91)
<i>Number of years lived in community</i>				
All my life	1	1	1	1
20 years or more	1.71 (0.50*)	1.37 (0.47)	0.86 (0.27)	0.72 (0.39)
10 to 19 years	1.37 (0.47)	1.18 (0.47)	0.87 (0.32)	1.1 (0.67)
less than 10 years	1.97 (0.77*)	1.53 (0.63)	0.68 (0.27)	1.16 (0.73)
<i>Crops cultivated</i>				
Other crops	1	1	1	1

Maize	1.96 (0.72*)	1.13 (0.44)	1.34 (0.52)	4.16 (4.43)
<i>Amount of rainfall in community</i>				
Not decreasing	1	1	1	1
decreasing_rainfall	0.94 (0.24)	1.06 (0.33)	0.32 (0.10***)	0.74 (0.34)
<i>Training on climate smart agriculture</i>				
None		1	1	1
Received training	1.53 (0.38*)	1.7 (0.50*)	0.86 (0.23)	2.53 (1.08**)
<i>Remittance money spent on</i>				
No crop farming activities	1	1	1	1
Constant	0.82 (0.58)	0.06 (0.06***)	0.1 (0.08***)	0.01 (0.01***)
F(22, 469)	98.02	234.15	112.49	26.34
R ²	0.1621	0.3712	0.1979	0.1128
P	0.0000	0.0000	0.0000	0.0000

Note ***, ** and * indicate significance at the 1, 5 and 10 % levels respectively

Source: Fieldwork, 2022

5.15 Determinants of adoption of usage of more pesticides and fertilizers

Among other contextual factors such as the economic and government structures, the data revealed that gender; community of residence of the farmer, level of education, and the years lived in the community, types of crops being cultivated as well as training on climate smart agriculture (**Table 5.12**). Male farmers are 3 times more likely to adopt the strategy as compared to female farmers. This was expected as per field interviews, women were discouraged from using pesticides and fertilizers because the scarcity of chemicals or the financial constraints in purchasing them. This was explained by a farmer below:

“My wife doesn’t use fertilizers or the pesticides. What she helps with is mixing them. But I feel uncomfortable with that. The agric officers said that it is not safe and could affect childbirth. So, I would not risk it...” (Farmer, Obawale).

However, regardless of government subsidies, farmers from Dabo were 3 times less likely to adopt the strategy as compared to Huhunya (the reference category). Likewise, farmers in Obawale were 3 times less likely to adopt the strategy as compared to Huhunya. This indicates that though according to field interviews farmers in the Yilo Krobo district may perceive that the farmers in the Northern Savannah Zone have more access to resources like pesticides and fertilizers this data suggests otherwise. It shows that there is an uneven distribution of resources in the Wa West district. Additionally, farmers with a JHS educational level are more likely to adopt the strategy. This could be that they are much more likely to utilize and adopt the skillset needed to apply the fertilizer or the pesticides in the right way or with the right quantity.

On the other hand, farmers who had stayed in the community for less than 10 years and those who had stayed there for 20 years or more were twice as likely to adopt the strategy. Nonetheless, this factor appears to be of less significance since it is $< 5\%$. Again, farmers who grew maize were twice as likely to adopt the strategy. This was however, surprising since the researcher had expected the findings to have a greater significance than it did. On the other hand, farmers who had received climate smart agriculture training were more likely to adopt the strategy. This is probably because of their much greater understanding on the importance of the application of fertilizers and pesticides (Zinyemba et al., 2021).

5.16 Determinants of Use of more machinery

As part of tillage practices, some farmers employ the use of tractors and ploughs in order to till their land and increase the chances of a crop yield. The data shows that some factors such as ages of the farmer, community of the farmer, level of education of the farmer as well as training on an agriculture smart programme determined if farmers adopted the strategy. The logistic regression

carried out shows that older farmers between the ages of 46-55 years were 6 times less likely to adopt the strategy as compared to those between the ages of 18-25. A likely reason for this observation could be that the older farmers might be too old to employ the use of heavy-duty machinery like tractors, which could prove strenuous to their health (Yaro et al., 2016). Another equally plausible reason would be that older farmers are much more comfortable with the indigenous way of tillage practices and would rather engage with that or try new ones. Again, farmers from almost all the communities had a higher times more likelihood of adopting the strategy except respondents from Obawale. Since this was the only community in Yilo Krobo which was 2 times less likely to adopt the strategy, the researcher assumes that it is likely due to financial constraints or uneven distribution to resources. On the other hand, farmers with primary and Jhs level of education were 2 times and 3 times less likely to adopt the strategy as compared to those with no formal education. In addition, farmers who had trained under a climate smart agriculture programme were 2 times more likely to adopt the strategy as compared to those who did not. This is probably as a result of understanding the importance of adopting the strategy that may emerge out of the training programme as well as access to rental services of the machinery. The researcher was however, surprised that gender was not a determining factor in the adoption of the strategy, since from field interviews, it was deduced that one's gender could play a pivotal role in whether one had access to the use of machinery or not. The data however, suggested otherwise.

5.17 Determinants of steps against erosion

As part of soil conservation practices, some farmers adopted afforestation as well as other ways and means to take steps against surface runoffs as well as any other effect of soil erosions. The factors that determined a farmer's adoption of the strategy includes but not limited to community of stay of the farmer, education and perception of rainfall. An analysis of the data reveals that

almost all communities, except Obawale had a high likelihood of adopting the strategy. However, as compared to the other determining communities, Akorley has a lower significance on determining if the farmers adopted the strategy. Furthermore, some farmers with shs/tertiary education are twice as likely to adopt the strategy as compared to those with no level of education. This is probably attributable to a better understanding of soil conservation as well as the gaining skillset needed to adopt it (Panta et al., 2020). On the other hand, farmers who perceived a decrease in rainfall were 3 times less likely to adopt the strategy. Hence, farmers are more likely to adopt the strategy if there is an increase in rainfall patterns.

5.18 Determinants of production of handicrafts

As a means to cope with income losses that resulted from lower crop yields, some farmers choose to engage in handicrafts production such as basket weaving, beading and dressmaking. There are some contextual and environmental factors that inform the adaptation of the strategy. These include access to financial resources, such as financial aid as well as accessibility to customers. Nonetheless, there are other significant factors that determine the farmers' decision to adapt to the strategy.

The data generated show that farmers who received climate smart agriculture training were 3 times more likely to adapt the strategy. This is likely because one of the aims of Climate Smart Agriculture (CSA) methods is to be economically and environmentally beneficial (Mizik, 2021). Though focus is often on agriculture methods, there are times that farmers are encouraged to engage in other avenues such as handicraft production to make extra income. In Ghana for instance, the government launched the National Climate-Smart Agriculture Action Plan to provide a platform for climate change, agriculture and food security (Zougmore & Partey, 2016). By

providing some financial mechanisms or by ensuring there are well running financial mechanisms put in place, farmers are more likely to adopt the strategy compared to farmers who did not undertake the training. Further analysis of the data also showed that there were no other significant determining factors of the strategy.

Table 5.13: Logistic regression of non-agricultural work, reduction in expenses

	Look for non-agricultural work	Reduction in Expenses
Variables	Odds Ratio (Std. Err.)	Odds Ratio (Std. Err.)
<i>Gender of respondent</i>		
Female	1	1
Male	0.81 (0.18)	1.24 (0.28)
<i>Age of respondent</i>		
18 – 25	1	1
26-35	0.68 (0.29)	1.05 (0.43)
36 – 45	0.47 (0.21*)	0.74 (0.32)
46 – 55	0.34 (0.17**)	0.58 (0.28)
56+	0.14 (0.07***)	0.65 (0.32)
<i>Community</i>		
Huhunya	1	1
Obawale	1.1 (0.46)	3.47 (1.47***)
Siiru	2.55 (1.14**)	0.3 (0.14***)
Dabo	5.1 (2.20***)	0.9 (0.37)
Siriyiri	5.9 (2.49***)	1.1 (0.44)
<i>Educational level of respondent</i>		
No formal education	1	1
Primary	1.75 (0.59*)	0.76 (0.25)
JHS	1.31 (0.4)	0.58 (0.18*)
<i>Marital status</i>		
Not married	1	1
Married	0.44 (0.11***)	1.23 (0.31)
<i>Number of years lived in community</i>		
All my life	1	1
20 years or more	1.45 (0.4)	1.97 (0.55**)
<i>Amount of rainfall in community</i>		
Not decreasing	1	1
Decreasing rainfall	0.4 (0.10***)	2.64 (0.63***)

<i>Distribution of rainfall</i>		
Not regular	1	1
Regular rainfall	1.76 (0.53*)	0.37 (0.11***)
<i>Training on climate smart agriculture</i>		
None	1	1
Received training	2.02 (0.48***)	1.28 (0.29)
Constant	1.35 (0.92)	1.08 (0.72)
F(22, 469)	95.95	84.57
R ²	0.1476	0.1303
P	0.0000	0.0000

Note ***, ** and * indicate significance at the 1, 5 and 10 % levels respectively

Source: Fieldwork, 2022

5.19 Determinants of looking for non-agricultural work

Though Yaro et al. (2016) report that a large section of farmers in rural economy are increasingly adopting non-agricultural work as a form of livelihood, in this study, less than 50% of sampled farmers adopted the strategy. This is because most non-agricultural work include agricultural processes, farm labour, trading, mining and civil jobs. Per the logistic regression carried out, the main factors that determined farmers' decision to look for non-agricultural work were age, community of stay, level of education, marital status, perception on climate change, and training on CSA.

The survey revealed that farmers within the age groups, 56+, 46-55 and 36-45 were less likely to adopt the strategy as compared to those within the ages of 18-25. This is in line with the findings in Yaro et al. (2016) who reported that in order to engage in some non-agricultural work, some farmers would have to be embodied with youthful physical capacity. This would explain why farmers between the ages of 18-25 are more likely to adopt the strategy. Below was a statement made by one of the farmers:

“My children are the ones who go to town to work. My son works as a security guard for one of the banks...I think that he is young so it is much better for him and the opportunities are more opened. He sometimes helps with money in the house and that’s what I use to buy some seedlings for the farm” (72 year old male farmer, Akorley).

In addition, farmers in the study communities in the Wa West district are more likely to adopt the strategy as compared to those in the Yilo Krobo district. This is likely because of the availability of natural capital such as wood as well as some food processing plant in the Wa West district. This provides opportunities for non-agricultural work. Interestingly, due to the location of Yilo Krobo in the Tropic Forest Zone, the researcher was inclined to think that most farmers would be employed to work in the timber Production Company as well as food processing unit in Akorley. This was however not the case. Nonetheless, the researcher believes that farmers would opt for other strategies they believe are much more beneficial. On the other hand, farmers with a primary level education are twice as likely to adopt the strategy as compared to those with no formal education. This is likely because they might have garnered the prerequisite skills needed for basic employment in the civil service. Moreover, the basic language skills including writing, and basic arithmetic would prove useful in the dealings of businesses. Correspondingly, farmers who were married were twice less likely to adopt the strategy. Another determinant of the strategy was farmers who perceived changes in the climate. Interestingly, farmers who perceived that rainfall was more regular were twice as likely to adopt the strategy, whereas those who perceived a decrease in rainfall were 3 times less likely to adopt the strategy. On the other hand, farmers who received training on CSA were 2 times more likely to adopt the strategy than those who did not. This is in line with the main aim of CSA, which is to derive economic benefits (Akrofi-Atitianti et

al., 2018); hence, it is likely that the farmers who were trained were equipped in one way or the other to pursue a non-agricultural work such as petty trading.

5.20 Determinants of reduction in expenses

An increase in temperature and a decrease in rainfall have an economic impact on rural farmers' livelihood. This is primarily because most farmers engage in rain-fed agriculture. In that case, unpredictable weather patterns could lead to crop failure, a decrease in the yield of grain crops such as maize, and livestock production, which can consequently result in decline in the revenue of farming households. Inadequate rainfall causes most unskilled farmer labour to utilize hours to collect water for irrigation and water collection. This could lead to a continual decline of the financial status of most farmers' households and as such, most households reduce their expenditure on food, weddings and other social functions like festivals (Udmale et al., 2014).

According to the data, the significant determinants of the adoption of the strategy are community of stay, level of education, length of stay in the community and the farmer's perception to rainfall.

Farmers in Siiru were 3 times less likely to adopt the strategy than farmers in Huhunya, whereas farmers in Obawale were 3 times more likely to adopt the strategy. On the other hand, farmers with a JHS level of education were twice less likely to adopt the strategy than those with no level of education. Though this was less significant <10%, it can be assumed that those with some degree of education are more likely to have other avenues opened up for them in the civil and public sector and that could help in supplementing the household income. Again, farmers who had lived in the community for 20 years or more were twice as likely to adopt the strategy as compared to those who had stayed in the community for their whole lives. On the other hand, farmers who perceived a decrease in rainfall were 3 times more likely to adopt the strategy than those who did not perceive

any decrease in rainfall. As mentioned earlier, most rural households depend on rainfall agriculture and a reduction or irregularity in rainfall is likely to cause a strain on household income. In this same vein, farms who believed that rainfall was regular was 3 Odd times less likely to adopt the strategy.

5.20 Conclusion

In accordance to answering research question two, findings from this chapter highlights the spatial and gendered dynamics of in-situ adaptations strategies adopted by farmers in Yilo Krobo and Wa West districts. Farmers in the Yilo Krobo and Wa West district have implemented a series of adaptation strategies such as irrigation, use of pesticides and fertilizers, the use of less farmlands and the reduction of expenses. Findings however showed that there were important nuances that informed the factors that influenced the choice and effectiveness of in-situ adaptation strategies. The chi test conducted further demonstrated that gendered and spatial differences played a significant role in influencing farmers' adoption of adaptation strategies. In-depth interviews and FGDs explained that spatial differences were evident in climate, terrain, economic structure and sometimes the availability of resources. For instance, due to the harsh and semi-arid weather conditions in the Wa West District, farmers were more likely to adopt certain strategies like irrigation and the use of drought-resistant crop varieties as compared to farmers in the Yilo Krobo District. Nonetheless, though climate and terrain of study areas were mostly due to their agro ecological locations, field interviews espoused that availability of districts' resources were mostly dependent on government assistance. For example, an FGD in Yilo Krobo revealed that as compared to the Wa West, farmers in the Yilo Krobo did not receive adequate irrigation materials as well as new crop varieties which created constraints in the overall adoption and effective implementation of the strategy. This outcome reaffirms the concept of entitlement failure espoused

by (Teye & and Owusu, 2015), whereby, farmer's access to resources is denied or limited as a result of the inadequacy of a government institution. In addition, economic structure in the districts was a key reason for spatial differences in adaptation strategies. Although farmers in both districts faced financial constraints in the adoption of a strategy, the prevalent poverty rate in the Wa West district meant that more farmers were likely to face financial constraints as compared to farmers in the Yilo Krobo. Nonetheless, the research further highlighted how gendered dynamics informed the adoption and effective implementation of the in-situ adaptations strategies. The research showed that women farmers were more likely to face constraints like accessing financial resources, information as well have the autonomy of making decisions. These were as a result of cultural structures like traditional inheritance systems, land ownership rights, and traditional gender norms which compelled rural women to combine their primary giver role with farming. These did not only limit their adoption of the strategies but it also influenced the types of adaptation available to them. This results reflects Giddens (1984), which purports the idea that structures in society in this case, cultural and economic structures impact the actions of some social actors. It is also in line with Leach et al. (1999) and Teye (2013) which establishes those social actors' rights and resources facilitates their access to resources to contribute to their well-being. Furthermore, the logistic regression carried out demonstrated that for most strategies, gender, age of respondents, community of stay, level of education as well as climate smart training determined farmers' adoption of the strategy.

The outcome of this chapter determines that the opportunities and constraints both men and women face in the adoption of adaptation strategies are attached to a range of factors such as social structures, one's access and rights to resources as well as location. It also establishes that the livelihoods of farmers in the forest zone are equally affected by climate change. The researcher

believes that understanding how these factors shape both men and women in the same and diverse spatial context will enable policymakers and stakeholders to provide an improved and more targeted and operational interventions for rural farmers in both districts. For example, efforts should be put in providing equal access to resources, training programmes as well as localized information outlets for farmers in places other than the Northern Savannah zone. In addition, female farmers should deliberately be included in decision making processes as well as authorized to keenly participate in adaptation planning and implementation.



CHAPTER SIX

CLIMATE-RELATED (IM)MOBILITY

6.1. Introduction

Over the years, studies have shown that migration has been used by most households in several ways like to diversify their income or to pursue social opportunities like marriage and education (Dustmann et al., 2023). It has however, over some time come to serve as an adaptation strategy for a majority of rural households in order to diversify livelihoods. In this chapter, in reference to research question 3, the researcher explains to what extent migration is used as an adaptation strategy in rural households in the Wa West and Yilo Krobo districts of Ghana. In addition, the chapter seeks to answer research question 4, by exploring the gendered dynamics of climate immobility in the Upper West and Eastern Regions of Ghana.

6.2 Non-Migrant and Migrant households in the Yilo Krobo and Wa West District

In accordance to research question 3, the researcher presents a table, displaying migrants and non-migrants household. For the sake of this study, migrant households are households that have members, who “temporarily or permanently have moved away within the last 10 years”. The researcher then proceeds to present reasons why the migrants moved. **Table 6.1**, shows the migrant and non-migrant household.

Table 6.1: Migrant and Non-Migrant households

Variables	Households with temporary or permanent migrants	Households without temporary or permanent migrants	Total	Chi square p value
	N (%)	N (%)	N (%)	
All	335 (71.4)	134 (28.6)	469 (100)	$\chi^2 = 7.0807$ Pr = 0.215
Yilo Krobo	164 (71.3)	66 (28.7)	230 (100)	
Huhunya	54 (65.9)	28 (34.1)	82 (100)	
Obawale	49 (80.3)	12 (19.7)	61 (100)	
Akorley	61 (70.1)	26 (29.9)	87 (100)	
Wa West	171 (71.5)	68 (28.5)	239 (100)	
Siiru	48 (68.6)	22 (31.4)	70 (100)	
Dabo	64 (79)	17 (21)	81 (100)	
Siriyiri	59 (67)	29 (33)	88 (100)	
Ages				$\chi^2 = 6.0956$ Pr = 0.192
18 – 25	31 (79.5)	8 (20.5)	39 (100)	
26 – 35	71 (64)	40 (36)	111 (100)	
36 – 45	110 (72.4)	42 (27.6)	152 (100)	
46 – 55	66 (77.6)	19 (22.4)	85 (100)	
56+	57 (69.5)	25 (30.5)	82 (100)	
All	335 (71.4)	134 (28.6)	469 (100)	$\chi^2 = 0.1033$ Pr = 0.748
Gender				
Male	172 (70.8)	71 (29.2)	243 (100)	
Female	163 (72.1)	63 (27.9)	226 (100)	
All	335 (71.4)	134 (28.6)	469 (100)	

Source: Fieldwork, 2022

The above table, **Table 6.1** shows that across regions, a significantly high percentage of households (71.4%) reported that their members have temporarily or permanently moved away. Despite the high percentages, this was not a surprising outcome. Accordingly, this is in line with earlier studies of Busso et al. (2021) and Weinreb et al. (2020), which argue that rural out-migration is exponentially on the rise. Some of these are attributed to social transformation, and in some instances cultural, social or political factors, like seeking better opportunities, marriage,

education, and in some places escaping climate shocks (Selod & Shilpi, 2021). As narrated by a female farmer:

“When my daughter completed Junior High School, she said that she wanted to further her education. But, there was no money. Her siblings in Accra asked her to come and work in Accra whilst they gathered some money for her fees. She is not the only one who has migrated. Most of our neighbours have migrated some with their children” (40-year-old female farmer, Dabo)

Further analysis of the results shows that among districts, there was not much difference in percentages of migrant households. This was an interesting outcome because available literature (Arthur-Holmes & Busia, 2022; Scully & Britwum, 2019) and data from the Ghana Statistical Service (GSS, 2014) show that the Wa West district is one of the main centers for out-migration in Ghana due to its high poverty rate. On the other hand, the Yilo Krobo district serves as the destination for most migrants because of its bimodal rainy season and its location in the forest zone. Hence, it was of no surprise that the results had shown that the Wa West district had 71.5% of migrant households. On the other hand, though the Yilo Krobo district has reported a negative net migration in recent years, the researcher had not expected both districts to have demonstrated a close range in the percentages of migrant households. Nonetheless, as established earlier, a likely reason for the high out-migration in the Yilo Krobo district may be due to its proximity to the capital region of Ghana, which is a popular destination for migrants:

“...moving to the capital city is not really a bother. It takes about two hours to get to Accra. So, my son stays there to work at a microfinance institution. He comes back for festivals or family events. During those occasions he brings his children to visit” (60 Year old male farmer, Akorley)

“They mostly move to Accra, sometimes to Ashaiman. They go and work in factories around Tema and come home during the holidays...” (32 years, male return migrant, Akorley)

In relation to gender, there was a close percentage in female and male migrants (72.1% and 70.1% respectively). This was fascinating because, though contemporary studies like the feminization of migration by Apatinga et al. (2022) shows that there is an increase in female migration in Ghana, many like Awumbila (2015) argue that there are more male migrants than female migrants due to existing structural constraints like traditional gender roles and inadequate economic incentives (Quartey et al., 2020). Nonetheless, through in-depth interviews as well as focus group discussions, it was economic hardships have led to an increased migration of women in search of improved living conditions:

“...when things are hard we mostly allow the women to migrate to Accra. It was not like that before but now taking care of the home is hard. Some family elders like her [female migrants'] uncles and brothers give her the permission to migrate. The truth is that for the women when they migrate, they come back home with something or even remit some food or money home. But the men will migrate and comeback home empty handed...” (81-year-old female farmer, Siriyiri).

“... It is due to the hardship that they travel. So, when they return, the little they bring they use it for the farming activities or even support the family if there is no food. ...” (Male FGD Siriyiri)

The aforementioned statements indicate that the present economic hardships have posed a challenge to pre-existing gender-based beliefs, leading to an increase in migration among women. This is also attributed to the belief that women tend to remit more (Guzmán et al., 2008; Singh, 2018).

Field interviews from the Yilo Krobo district reiterate sentiments from the Wa West district:

“If I were to be a father, I would let my daughter migrate because the women often send things home. But, you see the men they will use all their money to chase women and they would come home empty handed. Most of the houses here have been renovated by the women who send money back home...” (Male Respondent, Akorley FGD)

The statement affirms previous studies, such as (Asiedu and Chimbarm, 2020; Pickbourn, 2016), which suggest that women are more inclined to engage in remittance compared to men. A respondent from Obawale FGD gives a likely explanation:

“You see, if a woman migrates to another place, they find it easier to find work than men. They can even sell sachet water for someone to earn a commission. Men will feel shy to sell sachet water and soft drinks to earn some money” (Respondent from Obawale female FGD)

Despite the general consensus from both districts that there is an increase in female migration as result of the high remittances rate from women. In the Yilo Krobo district, focus group discussions uncovered that women specifically from Yilon Krobo were predominately motivated to migrate in search of marriage opportunities:

“In Northern Ghana, many families arrange marriage for their daughters and that is a reason why they do not support them to migrate. So, they keep their daughters and push their sons to migrate and earn money. Over here, it is a part of our culture to give liberties to our daughters to explore and find their husbands. So we push the women to go out and marry that are the cultural differences between Northern and Southern Ghana” (Youth FGD, Akorley).

This elucidates the spatial and gendered dynamics of migration in the two districts. Though both districts are patriarchal in nature and have common traditional gender roles, there are key gendered differences in how migration is utilized by households in these two districts. In the Yilo Krobo district for instant, women are traditionally encouraged to migrate whereas the men were asked to stay behind to take care of the home. In contrast, field interviews in the Wa West district depicted that women were migrating more than ever, however there were few structural constraints that restricted or discouraged the flow of female migrants such as the need to receive permission from a group of family elders. Therefore, though the patriarchy served as a structural constraint in the migration of women in the Wa West District, it facilitated the migration of women in the Yilo Krobo district. This finding reflects the idea that, migration as a livelihood and adaptation strategy is dependent on what the household and some instances family collectively decides. It also reflects the social and cultural organization of each district.

Testing of hypothesis

H₀: There is no significant relationship between gender and migration

The p values (0.748) of less than 10% but great than 5% depicts that though weak, there is a significant relationship between gender and migration. Therefore, the null hypothesis has been rejected and the alternate hypothesis has been accepted.



6.3 Reasons for Migration

Table 6.2: Reasons for migration

	Education	Marriage	Employment opportunity at destination/look for opportunities	Lack of farming land	Crop failure	Lack of work here	Floods	Droughts	Other	Total
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
All	86 (12.68)	47 (6.93)	280 (41.3)	38 (5.6)	48 (7.08)	135 (19.91)	5 (0.74)	24 (3.54)	15 (2.21)	678 (100)
Yilo Krobo	53 (14.4)	23 (6.25)	120 (32.61)	36 (9.78)	28 (7.61)	73 (19.84)	4 (1.09)	19 (5.16)	12 (3.26)	368 (100)
Huhunya	17 (15.32)	6 (5.41)	39 (35.14)	9 (8.11)	6 (5.41)	24 (21.62)	1 (0.9)	5 (4.5)	4 (3.6)	111 (100)
Obawale	18 (13.95)	5 (3.88)	41 (31.78)	14 (10.85)	12 (9.3)	25 (19.38)	0 (0)	14 (10.85)	0 (0)	129 (100)
Akorley	18 (14.06)	12 (9.38)	40 (31.25)	13 (10.16)	10 (7.81)	24 (18.75)	3 (2.34)	0 (0)	8 (6.25)	128 (100)
Wa West	33 (10.65)	24 (7.74)	160 (51.61)	2 (0.65)	20 (6.45)	62 (20)	1 (0.32)	5 (1.61)	3 (0.97)	310 (100)
Siiru	10 (11.49)	7 (8.05)	43 (49.43)	1 (1.15)	8 (9.2)	16 (18.39)	0 (0)	1 (1.15)	1 (1.15)	87 (100)
Dabo	8 (7.21)	8 (7.21)	59 (53.15)	0 (0)	3 (2.7)	32 (28.83)	0 (0)	0 (0)	1 (0.9)	111 (100)
Siriyiri	15 (13.39)	9 (8.04)	58 (51.79)	1 (0.89)	9 (8.04)	14 (12.5)	1 (0.89)	4 (3.57)	1 (0.89)	112 (100)
Age of respondent										
18 – 25	7 (11.11)	3 (4.76)	28 (44.44)	1 (1.59)	3 (4.76)	14 (22.22)	1 (1.59)	4 (6.35)	2 (3.17)	63 (100)
26 – 35	16 (11.68)	7 (5.11)	58 (42.34)	10 (7.3)	9 (6.57)	31 (22.63)	1 (0.73)	1 (0.73)	4 (2.92)	137 (100)
36 – 45	26 (11.45)	13 (5.73)	87 (38.33)	16 (7.05)	21 (9.25)	44 (19.38)	2 (0.88)	12 (5.29)	6 (2.64)	227 (100)
46 – 55	16 (12.5)	8 (6.25)	57 (44.53)	6 (4.69)	8 (6.25)	27 (21.09)	0 (0)	4 (3.13)	2 (1.56)	128 (100)
56+	21 (17.07)	16 (13.01)	50 (40.65)	5 (4.07)	7 (5.69)	19 (15.45)	1 (0.81)	3 (2.44)	1 (0.81)	123 (100)
All	86 (12.68)	47 (6.93)	280 (41.3)	38 (5.6)	48 (7.08)	135 (19.91)	5 (0.74)	24 (3.54)	15 (2.21)	678 (100)
Gender of respondent										
Male	45 (13.04)	24 (6.96)	139 (40.29)	19 (5.51)	28 (8.12)	65 (18.84)	2 (0.58)	13 (3.77)	10 (2.9)	345 (100)
Female	41 (12.31)	23 (6.91)	141 (42.34)	19 (5.71)	20 (6.01)	70 (21.02)	3 (0.9)	11 (3.3)	5 (1.5)	333 (100)
All	86 (12.68)	47 (6.93)	280 (41.3)	38 (5.6)	48 (7.08)	135 (19.91)	5 (0.74)	24 (3.54)	15 (2.21)	678 (100)

Source: Fieldwork, 2022

Respondents were probed on the reasons why household members migrated. Options given ranged from education, employment, marriages as well as effects of climate change like drought and poor crop yields (Kc, 2020). In **Table 6.2**, the results show that, across all regions 41.3% of household members migrated because of employment opportunities at the destination. This was followed by 19.91% who migrated because there was lack of work at the place of origin. While these two

factors are distinct, they are both shaped by economic structures and interconnected in why one might choose to migrate. Employment opportunities at the destination highlight ‘pull factors,’ whereas a lack of jobs at the origin represents ‘push factors.’ However, the subsequent quotes will provide insight into how these ‘employment opportunities’ at destinations and ‘lack of jobs’ at origin are fundamentally influenced by the interaction of climate change effects, as highlighted by the Foresight framework. Discussants from focus group discussion explained that some migrated during the dry season, when crop production is low in order to make some money:

“...there is nothing to be done here during the dry season. So it will be better to go somewhere maybe he [husband] will get something to support the family in this era of hardship. Sometimes when the season’s yield is not good, he goes to the Eastern Region to work as a farm laborer so that he can make enough money for us to buy food...” (Female FGD, Dabo)

Another stated persistent drought as a factor:

“...lack of job opportunities here motivated them to migrate. Also, the persistent drought during the farming season over here is a factor too. You know in the south they even have two raining seasons. All these are the motivating factors” (Male FGD, Sيريiri)

The above statement shows that, some migrants migrate in order to seek for employment opportunities elsewhere or due to lack of jobs in their place of origin. Despite this, an analysis of the statement reveals that these issues emerge as a result of climatic variations such as prolonged dry seasons and droughts. The relevance of the Foresight (2011) framework in this finding is underscored when one considers that climate change interaction with economic factors leads to no job opportunities in places of origin, as a result of this some may have to migrate. Some in-depth

interviews in the Yilo Krobo district states that climatic variations led to hunger in their households:

“Nowadays, there are very little yields from our farms. Our lives largely depend on them so if they fail then people have to move elsewhere to cushion themselves and their families. So it is just the unprofitable nature of farming these days that makes them to move” (33 year old female farmer, Huhunya)

Though the statement above did not explicitly state that low crop yields, or lack of farming lands motivated them to migrate, they did allude that, poor crop yield resulted in hunger in their households. This was as a result of a large percentage of farmers whose livelihoods dependent on the sale of crops on their farms. Failure of their crops meant a reduction in household income which could lead to hunger. Some also stated that low income as a result of poor crop yields meant that many had to seek for other means to take care of the household:

“...yes,, if people farm and don't get anything at the end of the harvesting due to rainfall or some of these things, they travel out to get something to come and support the family. This will help take care of their children education...” (Respondent, Youth FGD, Siiru)

When differentiated by districts, 32.61% of the respondents in the Yilo Krobo district migrated because of employment opportunities. This was followed by 19.84% of respondents who migrated because of lack of work in places of origin, whereas, 14.4% migrated because of education. On the other hand, in the Wa West District, 51.61% of the respondents migrated because of employment opportunities at the destination, followed by 20% of respondents who stated the lack of work at the origin and 10% migrated because of education. A keen observation shows that between the two regions, a larger percentage of respondents from the Wa West district as compared

to the Yilo Krobo District migrated because of employment opportunities. This is in line with studies such as Gravesen et al. (2020), who highlighted that majority of migrants from the Wa West Districts move because of job opportunities. As mentioned in chapter two, the Wa West district is one of the poorest regions in the country due to its location in an arid and semi-arid agro-ecological zone. As with other parts of Ghana, a majority of farmers in this region rely on rainfall agriculture. This implies that harsh climatic conditions could result in a decline in agricultural productivity thereby prompting farmers to seek for greener pastures elsewhere.

Subsequently, when differentiated by age groups, a large percentage of respondents in all age groups migrated due to employment opportunities at the destination. Of this, a larger percentage was those within the ages of 18-25 and 26-35 year old. What this suggests is that a majority of the youth migrated to seek employment opportunities. This is in line with the findings of Maurya et al. (2022), study on youth migration in India, which establishes that most youth leave their rural household in search of better job opportunities in urban centres and in some cases other rural communities. Therefore, many opt to migrate for employment opportunities. Additionally, studies by Amare et al. (2021) on youth migration in Nigeria and Sub-Saharan Africa, shows that wage differentials at places of destination, as compared to places of origin serves as a motivation for the youth. This is often the case for rural-urban migration (Awumbila et al., 2017). This is because, the perceived favourable economic and infrastructural structures in the urban centres encourages the out migration of the youth.

In relation to gender, a slightly higher percentage of female migrants as compared to males migrated due to employment opportunities at the destination. In addition, 21.02% of women migrated because of lack of work at the origin in contrast to 18.82% of men. This indicates that more women were migrating due to economic incentives. Awumbila et al. (2008) study on head porters in Accra, highlighted how female migrants move to urban centres due to economic

incentives like better employment opportunities. This is to enable them to gather funds for better living conditions back home, or to save towards marriage.

In this study, it can be said that household members of various social groups did not primarily migrate because of the direct impact of climate change such as drought, flooding or low crop yields. However, as eluded by Foresight (2011) climate change multiplied the pre-existing stressors. For example, high temperatures and low rainfall over a period could lead to drought. This causes low crop yields. Since most households depended on the sale of crop yields for income, low crop yields implied a decline in income, which means low capital for farm inputs like irrigation equipment. This infers that farmers were likely to have poor adaptive capacity (Teye & Owusu, 2015). Consequently, climate change might not be a direct cause for migration in this study. It nonetheless, interacts with economic and social factors, which motivate the migration decision of household members (Foresight, 2011).

6.4 Duration of Migrants

Table 6.3: Duration of migration by Gender

	Permanent abroad (5 years)	Permanent in- country (5 years)	Recurrent/short-term	Daily commute work/school	Returned migration	Other	Chi-squared
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	
All	51 (8.2)	357 (57.4)	145 (23.3)	9 (1.4)	59 (9.5)	1 (0.2)	$\chi^2 = 134.2833$ Pr = 0.000
Yilo Krobo	36 (13.3)	190 (70.1)	38 (14)	2 (0.7)	5 (1.8)	0 (0)	
Huhunya	17 (16.8)	60 (59.4)	18 (17.8)	2 (2)	4 (4)	0 (0)	
Obawale	7 (10.9)	54 (84.4)	3 (4.7)	0 (0)	0 (0)	0 (0)	
Akorley	12 (11.3)	76 (71.7)	17 (16)	0 (0)	1 (0.9)	0 (0)	
Wa West	15 (4.3)	167 (47.6)	107 (30.5)	7 (2)	54 (15.4)	1 (0.3)	
Siiru	3 (2.9)	53 (51.5)	40 (38.8)	1 (1)	5 (4.9)	1 (1)	
Dabo	8 (6.8)	41 (35)	36 (30.8)	2 (1.7)	30 (25.6)	0 (0)	
Siriyiri	4 (3.1)	73 (55.7)	31 (23.7)	4 (3.1)	19 (14.5)	0 (0)	
Age of migrant							

Less than 18	1 (3)	13 (39.4)	18 (54.5)	1 (3)	0 (0)	0 (0)	$\chi^2 = 127.1760$ Pr = 0.000
18 – 25	2 (1.4)	82 (56.9)	44 (30.6)	3 (2.1)	13 (9)	0 (0)	
26 – 35	15 (5.9)	153 (60)	55 (21.6)	3 (1.2)	28 (11)	1 (0.4)	
36 – 45	9 (7.2)	87 (69.6)	18 (14.4)	1 (0.8)	10 (8)	0 (0)	
46 – 55	15 (32.6)	19 (41.3)	6 (13)	0 (0)	6 (13)	0 (0)	
56+	9 (47.4)	3 (15.8)	4 (21.1)	1 (5.3)	2 (10.5)	0 (0)	
All	51 (8.2)	357 (57.4)	145 (23.3)	9 (1.4)	59 (9.5)	1 (0.2)	
Gender of migrant							
Male	32 (7)	254 (55.7)	113 (24.8)	9 (2)	48 (10.5)	0 (0)	$\chi^2 = 13.3203$ Pr = 0.021
Female	19 (11.4)	103 (62)	32 (19.3)	0 (0)	11 (6.6)	1 (0.6)	
All	51 (8.2)	357 (57.4)	145 (23.3)	9 (1.4)	59 (9.5)	1 (0.2)	

Source: Fieldwork, 2022

The study further asked for the average duration of stay of the migrants. This was cross tabulated with gender in order to understand the relationship between gender and the the duration of a migrant. In **Table 6.3**, 57.4% of migrants across regions were permanent in country migrants who had stayed within a period of 5 years. On the other hand, 23.3% are recurrent/short term migrants with 9.5% being returned migrants. This outcome suggests that while literature, such as Anarfi (2003), Awumbila et al. (2011), and Cebotari and Dito (2021), highlights the prominence of international migration, the findings demonstrate that internal migration tends to be more common than other forms of migration (Alatinga, 2019). This could be attributed to the fact that internal migration is generally cheaper and less expensive than international travel. Additionally, the legal and logistical challenges associated with international migration, such as the complex and often stressful bureaucratic procedures for obtaining travel documents like visas (Ackah & Medvedev, 2012), play a significant role. Furthermore, individuals may choose internal migration due to their existing social networks in their home country and their familiarity with the culture, social structure, and language within their homeland (Munshi, 2020).

When spatially differentiated by districts, 70.1% of the migrants from Yilo Krobo accounted for permanent in country migrants who had stayed for a period of 5 years; this was followed by 14 % who were recurrent/short term migrants and 13.3% permanent migrant who had stayed abroad for 5 years. In contrast, the Wa West district had 47.6% of its migrants as permanent in country migrants (5 years), 30.5% as recurrent short term and 4.3 % permanent abroad migrants. This finding demonstrates that a majority of migrants from Wa West engaged in short term migration as compared to migrants in the Yilo Krobo who tends to be more permanent internal migrants. According to Gravesen et al. (2020), the higher number of short-term seasonal migrants from the Wa West region can be attributed to various factors, including agricultural opportunities, environmental conditions, historical and cultural factors, and economic conditions. For instance, the Wa West region has a historical and cultural tradition of migrants participating in short-term migration, often driven by environmental conditions like the region's unimodal rainfall and long dry season. Consequently, many migrants from the Wa West district seek out areas with more favorable agricultural prospects until the dry season subsides.

Another interesting observation from the data is that a noticeably lower percentage of migrants from the Wa West district were abroad compared to those from Yilo Krobo. This discrepancy might be attributed to the higher prevalence of financial constraints among migrants in the Wa West district, possibly due to the higher poverty rate in the Wa West district:

“I would love to go to Mali. I heard things are very profitable there... but it is very expensive. More than expensive. So it is much better to move to Accra for some work. Maybe if funds are gathered from working in Accra one can meet a connection man and travel...” (23 -year-old boy, Siriyiri)

Subsequently, regarding age groups, a large percentage of 36-45 years old were permanent in country migrant for a period of 5 years, with 30.6% as recurrent/short term migrants between the ages of 18-25 years old, and 56+ recording 47.4% migrants as permanent migrants who have been abroad for 5 years. Migrating outside the country is a capital-intensive venture (Maskus, 2023). This may mean that younger migrants may not have gathered enough to fund their international migration intentions. In comparison, older migrants may have saved some money over the years or may have built the necessary networks that could source the international travel. Others too, may have older children who travel and finance their travel:

“My son is in the United Kingdom. His wife gave birth and they invited my wife to come over. That was some years ago. Over time my wife has been going over and I rather stay...” (60 year old man, Dabo)

On the hand, in relation to gender, a significantly larger percentage of women were permanent in country migrants of 5 Years as compared to men. This was followed by 24.8% of male migrant who were short term/ recurrent migration as compared to 19.8% of women:

“...the men usually return earlier; you know they are farmers. So, they will return first and start preparing their farmlands while waiting for the women to return, by the time the women return their farms will be ready for sowing” (Youth FGD, Siiru)

In addition, it can be observed that a larger percentage of women travel abroad as compared to men. This may be due to favourable opportunities which maybe gender biased such house help services in Kuwait, caregiving and nursing opportunities in the UK. An interviewee stated the following about his sister:

“Oh she is in Saudi, she is working there as a maid. It’s a contract so she will be back when she is done...” (39 year old Male farmer, Akorley).

6.5 Destination of migrants

Table 6.4: Cross Tabulation of Destination of migrants and gender

Gender of migrants	Capital of Ghana	Another urban area in Ghana	Rural settlement	Abroad	Total	
	N (%)	N (%)	N (%)	N (%)	N (%)	
Male	51 (11.2)	256 (56.1)	110 (24.1)	39 (8.6)	456 (100)	$\chi^2 = 6.0845$ Pr = 0.108
Female	23 (13.9)	84 (50.6)	35 (21.1)	24 (14.5)	166 (100)	
All	74 (11.9)	340 (54.7)	145 (23.3)	63 (10.1)	622 (100)	

Source: Fieldwork, 2022

The researcher proceeded to cross tabulate gender by destination. This was to give insight into understanding how gender determined the destination of migrants. **Table 6.4** shows that 56.1% of male migrants moved to another urban area in Ghana in comparison to 50.6% of female migrants who migrated to other urban areas. Field interviews from the Yilo Krobo district for instance highlighted that women were just as likely as men to migrant to other urban areas:

““Most of the guys go to farther places like and Ashaiman and the majority of the ladies go to the nearby places like Nkurakan, Koforidua, and Somanya to learn dressmaking and hairdressing. (Female FGD, Obawale).

Often the move to other urban areas is due to the prospects of getting a job do to, as compared to struggling to get a job in the capital city of Ghana:

“...some of the people go to Accra, and then they return. For me, I noticed that getting a meal in Accra was very expensive. Meanwhile over here I could eat several free food. I thought about it and decided to come back. But I’m thinking of moving again, maybe to Sunyani... you know that that could help look after the family...” (Return Migrant, Akorley)

The data further indicates that, a greater proportion of male individuals had relocated to different rural areas in comparison to their female counterparts. This observation aligns with the findings of Arthur Holmes and Busia (2022), who assert that a higher number of male migrants choose to move to other rural settlements specifically to engage in work, such as farm labor or artisanal farming. Typically, these males undertake such employment during the off-farming season, continuing until the next season commences:

“Yes we do migrate. Most of the youth run down there to work as laborers in people’s cocoa farms in the Ashanti region. Some too go down the savanna region around Larinbaga areas to work on people’s cassava farms, both men and women... We have some of them that are in Kalanton, around Larinbaga side, some too are around Atebubu” (25 year old Male farmer, Siriyiri)

On the other hand, a higher percentage of female migrants moved abroad as compared to male migrants. This was not surprising because in recent years, most traveling opportunities are popularly been skewed towards women such as housekeeping jobs in Saudi and Arabs, nursing opportunities in the UK as well as other opportunities that are favourable towards women.

6.6 Types of Migration

Amoah et al. (2021) shows that rural households that are economically inadequate often opt to seasonally migrate. Relatedly, Campbell (2021) work on seasonal migration in India, shows that short term and seasonal migration have been integrated into the livelihoods of poor rural household

in order to cope with economic strain. Additionally, Yadav (2020) proves that seasonal migration and temporal migration often serve to be beneficial to households. In the light of this, this study sought to understand the types of migration adopted by household in order to adapt to climate change. This ranged from those who seasonally migrated to urban areas, those who seasonally migrated to rural areas, those who migrated sometimes to urban areas, those who migrated sometimes to rural areas as well as short or long-term migration abroad. The results are shown in

Table 6.5 below

Table 6.5: Migrant household migration strategies for adapting to climate change

	Seasonal migration (annually) to urban areas N (%)	Migrated only sometimes to urban areas N (%)	Seasonal migration (annually) to rural areas N (%)	Migrated only sometimes to rural areas N (%)	Short- or long-term migration abroad N (%)
All	86 (18.3)	99 (21.1)	74 (15.8)	93 (19.8)	31 (6.6)
Yilo Krobo	20 (8.7)	52 (22.6)	20 (8.7)	28 (12.2)	3 (1.3)
Huhunya	14 (17.1)	26 (31.7)	16 (19.5)	10 (12.2)	1 (1.2)
Obawale	1 (1.6)	7 (11.5)	1 (1.6)	6 (9.8)	0 (0)
Akorley	5 (5.7)	19 (21.8)	3 (3.4)	12 (13.8)	2 (2.3)
Wa West	66 (27.6)	47 (19.7)	54 (22.6)	65 (27.2)	28 (11.7)
Siiru	15 (21.4)	11 (15.7)	19 (27.1)	27 (38.6)	2 (2.9)
Dabo	25 (30.9)	16 (19.8)	19 (23.5)	21 (25.9)	22 (27.2)
Siriyiri	26 (29.5)	20 (22.7)	16 (18.2)	17 (19.3)	4 (4.5)
Age					
18 – 25	13 (33.3)	14 (35.9)	9 (23.1)	7 (17.9)	2 (5.1)
26 – 35	24 (21.6)	32 (28.8)	15 (13.5)	21 (18.9)	6 (5.4)

36 – 45	31 (20.4)	31 (20.4)	25 (16.4)	34 (22.4)	12 (7.9)
46 – 55	9 (10.6)	11 (12.9)	18 (21.2)	22 (25.9)	7 (8.2)
56+	9 (11)	11 (13.4)	7 (8.5)	9 (11)	4 (4.9)
All	86 (18.3)	99 (21.1)	74 (15.8)	93 (19.8)	31 (6.6)
Gender					
Male	24 (10.6)	31 (13.7)	44 (18.1)	50 (20.6)	26 (10.7)
Female	62 (25.5)	68 (28)	30 (13.3)	43 (19)	5 (2.2)
All	86 (18.3)	99 (21.1)	74 (15.8)	93 (19.8)	31 (6.6)
<i>Chi-squared</i>					
Gender	$\chi^2 = 17.3487$ Pr = 0.000	$\chi^2 = 14.3120$ Pr = 0.000	$\chi^2 = 2.0579$ Pr = 0.151	$\chi^2 = 0.1769$ Pr = 0.674	$\chi^2 = 13.6641$ Pr = 0.000

Source: Fieldwork, 2022

The above table shows that across regions a larger percentage of migrants “migrated sometimes to urban areas” as compared to household members who “migrated sometimes to rural areas”. Migrants who “seasonally migrated to rural areas” accounted for 19.8% as compared to 18.3% of migrants who “seasonally migrated to urban areas”. This implies that majority of migrants move to urban centres as referred to earlier data presented in this study. It also presupposes that most will migrate to urban centres in order to attain what they believe are lacking in their place of origin.

When spatially differentiated by districts, 22.6% of the migrants from Yilo Krobo were said to have “migrated only sometimes to urban areas”. Then again, 12.2% of migrants only “migrated sometimes to rural areas”. In comparison to Wa West districts, 27.6 % of the respondents “seasonally migrated to urban areas”. Again, 27.2% of migrants, “migrated only sometimes to

rural areas” and 22.6% “seasonally migrated to rural areas”. This is indicative that most migrants in the Wa West district engage in “Seasonal migration” as compared to Yilo Krobo. This is in line and confirms the position of scholars who argue that poor households often adopt seasonal migration. Given that the Wa West district is the poorer of the two districts, it is plausible that more migrants will adopt seasonal migration. However, certain identical factors like financial constraints, education and other social and economic factors in the two regions may cause people to migrate. Available data in this study (**Table 6.5**) shows that in the Yilo Krobo district, it was much more common for migrants to “migrate for a shorter period of time to urban centres”. This might be attributable to the region’s proximity to the regional capital, Greater Accra. Accordingly, the road network from the Eastern Region to Greater Accra region enables easy travel routes for migrants from the Yilo Krobo district. Per field interviews, it was gathered that those who “only migrated sometimes to the urban centres” did so in search for daily commute jobs or to shop for goods in order to retail:

“...you see that store there. I go to Accra every Saturday. I used to go there every two weeks but now days it’s monthly. I go and buy things to come and fill the shop...” (42-year-old woman, Obawale).

Among the age groups, a large percentage of migrants between the age groups of 18-25 and 26-35 years old migrated “only sometimes to urban area”. Again, majority of migrants between the age groups of 36-45 and 46-55 years old migrated “only sometimes to rural areas”. This dynamics is in harmony with previous works that have shown that the youth population often migrates to other areas as compared to those within other age groups.

In relation to gender, 28% of female migrants “migrated only sometimes to urban centres”; this was followed by 25.5% who “seasonally migrated to urban centres.” In comparison, 20.6% of male migrants “migrated only sometimes to rural areas” followed by 18.1% who “seasonally migrated to rural areas”. This confirms the position of Rietveld et al. (2020) on youth and migration in Uganda. In it, the authors affirmed that where women migrants often moved to urban centred either for reasons ranging from marriage, accompanying a spouse to an urban centre or solely migrating to an urban centre because of employment opportunities. Abdulai et al. (2021) and Baada et al. (2019) studies on female migration in Ghana, highlight how women often moved to urban centres as compared to men. Yet in most cases, it was men who often moved to rural areas, to work as farm labourers or as artisanal miners to gather some money and move back home just on time to start the new farming season:

“...the men usually return earlier; you know they are farmers. So, they will return first and start preparing their farmlands while waiting... what happens is that when one is done with the farming season work, he will move down in search of money for the next season here” (Female farmer, Dabo)

6.7 Remittances and Climate resilience

According to Entzinger and Scholten (2022), low-income households are often the main beneficiaries of remittances. These remittances are often used for basic household needs:

“They mostly send money. Once in a while they will send oil and some food provisions like sardines and tin tomatoes...when that happens it reduces the money I will have used to buy those things”

(31 year old Male farmer, Akorley).

In lieu of this, the researcher understands that the regularity of remittances to a household can determine its dependency level. Again, remittances aided in supplementing household income (Adu-Okoree et al., 2012). It also builds income shocks for the family (Quartey, 2006) and builds the climate resilience of households (Mills, 2023). In this study, the researcher asked respondents the regularity of food and cash remittances received in households. The results have been presented in **Table 6.6**

Table 6.6: Regularity of Food Items and cash Regularity of remittances

	Weekly (Weekly)	Monthly (Monthly)	Quarterly (Quarterly)	Yearly (Yearly)	Not applicable (Not applicable)	Total (Total)
All	4 (1.2)	96 (27.8)	103 (29.9)	108 (31.3)	34 (9.9)	345 (100)
Yilo Krobo	0 (0)	39 (27.5)	60 (42.3)	43 (30.3)	0 (0)	142 (100)
Wa West	4 (2)	57 (28.1)	43 (21.2)	65 (32)	34 (16.7)	203 (100)
Ages						
18 – 25	1 (2.9)	11 (32.4)	5 (14.7)	10 (29.4)	7 (20.6)	34 (100)
26 – 35	0 (0)	22 (29.7)	22 (29.7)	23 (31.1)	7 (9.5)	74 (100)
36 – 45	0 (0)	18 (20.5)	34 (38.6)	27 (30.7)	9 (10.2)	88 (100)
46 – 55	1 (1.6)	11 (17.5)	22 (34.9)	26 (41.3)	3 (4.8)	63 (100)
56+	2 (2.3)	34 (39.5)	20 (23.3)	22 (25.6)	8 (9.3)	86 (100)
Gender						
Male	3 (1.7)	48 (27.6)	50 (28.7)	60 (34.5)	13 (7.5)	174 (100)
Female	1 (0.6)	48 (28.1)	53 (31)	48 (28.1)	21 (12.3)	171 (100)
All	4 (1.2)	96 (27.8)	103 (29.9)	108 (31.3)	34 (9.9)	345 (100)

Source: Fieldwork, 2022

The above table shows that across all regions, 31.3% of migrants remitted yearly. That is, a large percentage of migrants remitted largely than in other times. This was followed by 29.9% who

remitted quarterly and 27.8% who sent remittances monthly. When spatially differentiated among districts, in Yilo Krobo, 42.3% of respondents reported receiving remittances quarterly, 30.3% remitted yearly and 27.5% remitted monthly. On the other hand, 32% of respondents in Wa West district reported receiving remittances yearly, 28.1% reported monthly and 21.2% quarterly.

In reference to the age groups, 41.3% of household migrants between 46-55 years remitted yearly, 39.5% of migrants 56+ years remitted monthly and 38.6% between the ages of 36-45 years remitted quarterly.

In relation to gender, 34.5 % of the males remitted yearly as compared to 28.1% of the females migrants, 31 % of females remitted quarterly as compared to 28.7% males and 28.1% females remitted monthly as compared to 27.6% of males. Although a higher percentage of men remitted yearly, the above data show that a higher percentage of women remitted regularly; that is quarterly. In addition, it depicts that women are just as likely to remit as men are. It also converges with Rahman and Salisu (2023) study which shows that women remitted more and regularly. Additionally, Al-Sharmani (2010) work on Somali diaspora, indicates that women remitted cash remittances more, this not only aided in family upkeep but also, enabled the facilitation of migrants. Awumbila (2015) equally suggests that women remitted cash and food more regularly and for a longer period in time. She further argues that women remitted more regularly and for longer periods despite generally receiving lower wages than men (p. 137).



6.8 Use of Remittances

Table 6.7: Use of cash remittances

	Food	Education	Health care	Marriage /Funeral	Farming– seeds/ insecticides	Farming – livestock	Land purchase	House construction	Other	Total
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
All	207 (79.31)	79 (30.27)	134 (51.34)	33 (12.64)	138 (52.87)	21 (8.05)	3 (1.15)	22 (8.43)	9 (3.45)	261 (247.51)
Yilo Krobo	83 (76.15)	38 (34.86)	52 (47.71)	26 (23.85)	63 (57.8)	6 (5.5)	2 (1.83)	10 (9.17)	6 (5.5)	109 (262.39)
Wa West	124 (81.58)	41 (26.97)	82 (53.95)	7 (4.61)	75 (49.34)	15 (9.87)	1 (0.66)	12 (7.89)	3 (1.97)	152 (236.84)
Ages										
18 – 25	21 (84)	10 (40)	13 (52)	1 (4)	9 (36)	3 (12)	0 (0)	3 (12)	2 (8)	25 (248)
26 – 35	49 (83.05)	20 (33.9)	35 (59.32)	7 (11.86)	27 (45.76)	3 (5.08)	0 (0)	3 (5.08)	0 (0)	59 (244.07)
36 – 45	57 (77.03)	29 (39.19)	36 (48.65)	9 (12.16)	44 (59.46)	7 (9.46)	2 (2.7)	8 (10.81)	2 (2.7)	74 (262.16)
46 – 55	39 (75)	12 (23.08)	21 (40.38)	5 (9.62)	28 (53.85)	3 (5.77)	1 (1.92)	1 (1.92)	4 (7.69)	52 (219.23)
56+	41 (80.39)	8 (15.69)	29 (56.86)	11 (21.57)	30 (58.82)	5 (9.8)	0 (0)	7 (13.73)	1 (1.96)	51 (258.82)
Gender										
Male	102 (77.86)	40 (30.53)	66 (50.38)	21 (16.03)	72 (54.96)	14 (10.69)	3 (2.29)	18 (13.74)	3 (2.29)	131 (258.78)
Female	105 (80.77)	39 (30)	68 (52.31)	12 (9.23)	66 (50.77)	7 (5.38)	0 (0)	4 (3.08)	6 (4.62)	130 (236.15)
All	207 (79.31)	79 (30.27)	134 (51.34)	33 (12.64)	138 (52.87)	21 (8.05)	3 (1.15)	22 (8.43)	9 (3.45)	261 (247.51)

Source: Fieldwork, 2022

According to Kaczan & Orgill-Meyer (2020), the migration of a household member is a collective decision undertaken by other household members often to diversify livelihoods through remittances. Remittances are sent by migrants to aid in poverty alleviation through income supplement. They are at times used to buy farm inputs in order to maximize productivity. In this study, the researcher asked household members, what cash remittances sent by migrants is used for. In **Table 6.7**, 79.31% of respondents stated that cash remittances were used for foods, this was followed by 52.87% that used cash for farming seeds and insecticides. Again, 51.34% used it

for healthcare. These findings confirm those of Debnath and Nayak (2022), where it was revealed that majority of recipient households used remittances on food consumption. Additionally, a survey in Bangladesh by Moniruzzaman (2022), showed that the migration and remittances of a migrants boosted the security of migrants' households by reducing food related uncertainties and improving the quality of diet in recipients' households.

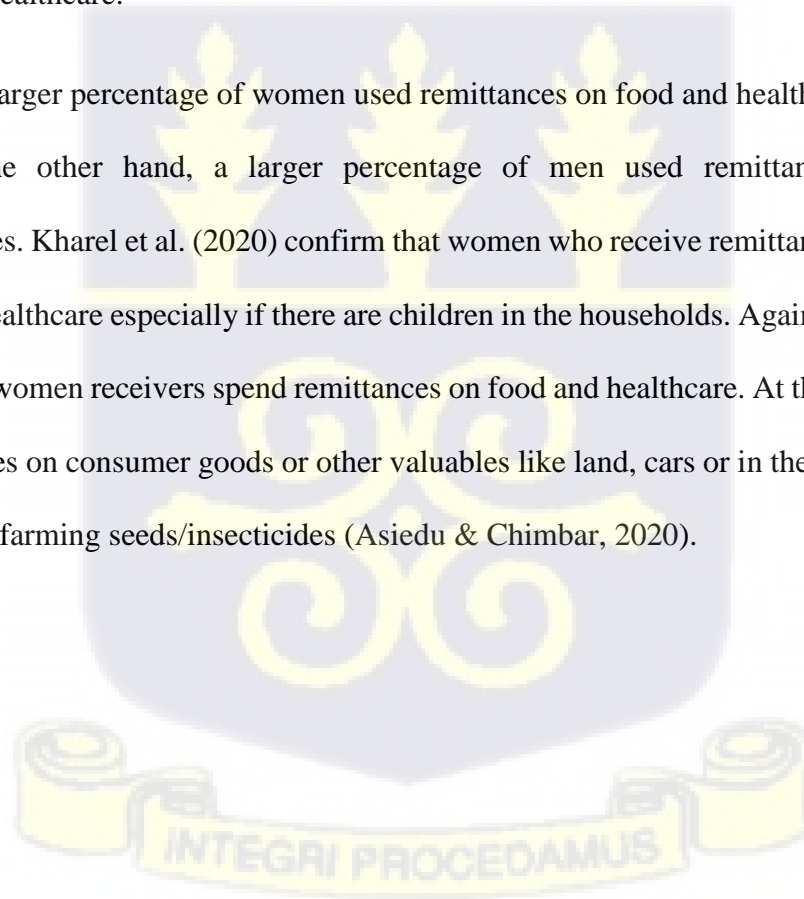
When spatially differentiated by districts, 76.15 % of recipient households used remittances for food, followed by 57.8% who used it on farming seeds and insecticides and 47.71% used for healthcare. On the other hand, 81.58% of recipient households in Wa West district used it for food. This is followed by 53.98 % of recipient households who used it on health care and 49.34% who used it on farming-seeds/insecticides. Findings from the two districts highlight that a majority of household members use remittances for food consumption. Hence, food security is provided to most migrant households. This finding is however, contrary to studies carried by (Atuoye et al., 2017), where the authors argue that remittance were not sufficient in alleviating food insecurity. The authors in the study suggest that although remittances receiving households tend to spend on food consumption, non-remittance receiving household have a higher food security. Despite this, several studies like (Ebadi, 2019; Mabrouk & Mekni, 2018) highlight how financial remittances boost food security in households, enabling them to invest income earned in other areas. Field interviews from this study for instance, point out how financial remittances aid in food security in both districts:

“...it helps me to feed the young ones. It's not enough but without it when the mango season does not the go well the children will starve. So I use it to top up some of the money in the house” (28-year-old female, Akorley)

“...sometimes he [son] sends us money. The last time he went, he sent 200 cedis to his father for the family management. His father then gave it to me. That is what I used to buy food stuff for the house... he used to send food stuff but the money is much better, it can be used for several things plus food” (57-year-old woman, Siiru)

Across the various age groups, a large percentage of respondents spent remittances on food. Of this percentage, a large percentage of respondents belonged to the ages of 56+ years (80%). In addition, 59.46% of the respondents between 36-45 years spending remittances on farming, that is seeds/ insecticides whereas 59.32% of respondents between the ages of 26-35 years spent remittances on healthcare.

Gender wise, a larger percentage of women used remittances on food and healthcare as compared to men. On the other hand, a larger percentage of men used remittances on farming-seeds/insecticides. Kharel et al. (2020) confirm that women who receive remittances usually spend it on food and healthcare especially if there are children in the households. Again Bryceson (2019) establishes that women receivers spend remittances on food and healthcare. At the same time, men spend remittances on consumer goods or other valuables like land, cars or in the case of this study farm inputs like farming seeds/insecticides (Asiedu & Chimbar, 2020).



6.9 Duration of stay and remittances

Table 6.8: Cross tabulation of duration of stay with Remittances

	Remittances	No remittances	Total
	N (%)	N (%)	N (%)
Permanent abroad (5 years)	38 (74.5)	13 (25.5)	51 (100)
Permanent in- country (5 years)	290 (81.2)	67 (18.8)	357 (100)
Recurrent/short-term	105 (72.4)	40 (27.6)	145 (100)
Daily commute work/ school	9 (100)	0 (0)	9 (100)
Returned migration	50 (84.7)	9 (15.3)	59 (100)
Other	0 (0)	1 (100)	1 (100)
Total	492 (79.1)	130 (20.9)	622 (100)
P-value	$\chi^2 = 12.8532$ Pr = 0.025		

Source: Fieldwork, 2022

Stark (1985) uses the remittances decay hypothesis has been used to explain the relationship between migrants and remittances. The remittance decay hypothesis suggests that over time, migrants' attachment to family ties and places of origins wanes, hence the amount of remittances sent by migrants to their country of origin declines. Despite this, Sricharoen (2021) show that factors other than the length of stay of migrants influences remittances. A cross-tabulation between duration of stay and remittances carried out in this study shows that 100% of migrants who engaged in daily commute to work and school remitted. Due to the daily commute, one bolstered their connection to the family daily. In addition, daily commute meant that they often had first-hand information on what the household needs were. On the other hand, 81.2% of permanent in country migrants remitted as compared to 74.5 % of migrants who had been abroad for a minimum of 5 years. This supports the findings of Bunduchi et al. (2019), indicating that the duration of a migrant's stay abroad and the decreasing frequency of visits to their home country are associated with weakened connections to their household. Consequently, the frequency and timing of

remittances are influenced. This trend is likely due to the fact that internal migrants tend to regularly visit their places of origin.

“The first born, a girl is Accra. The second one is also a girl, she is married so she is Brong Ahafo with her husband and children. The children sometimes come home when there are out-doorings. Just the other day, my niece was getting married, and my children came. It was a nice programme they sponsored the canopies and the drinks. It reduced the cost of the wedding totally” (70 year old farmer, Obawale).

In comparison, migrants who were abroad, visited home less regularly and relied on other means of communication to be updated of family events:

“...my son is in the UK...I haven't seen him in so many years. We talk on phone sometimes we have video calls. After he renovated the house, he hardly sends money. But when you ask him, he tries to send something small”

6.10 Climate Immobility

There is limited evidence, which suggests that climate immobility in Ghana has received the same policy attention as climate mobility. Yet anecdotal evidence and studies like Amo-Agyemang (2023), Hillmann and Ziegelmayer (2016), and Jackson (2021) show the presence of climate immobility in Ghana. The question guiding the researcher in this section is research question 4: Are there gendered differences in climate immobility in the Upper west and Eastern regions of Ghana? To answer this, the section builds theoretically on the Foresight framework to explore how factors like family obligation; traditional norms as well as financial constraints cause immobility. It also sheds light on how the concept of immobility can be explained by social, economic, political, cultural and psychological factors (Schewel & Fransen, 2022), as well as clarified by the

interaction of these factors and changes in the environment (Foresight, 2011). The researcher however admits and appreciates the continuous need to disentangle the complex narrative that surrounds the types of immobility (Wyngaarden et al., 2023). Hence, for the sake of this study, immobility includes people who want to migrate but lack the capability to leave (Carling, 2002), which maybe because of inadequate funds or lacking the right papers for travelling. Field interviews were incorporated to expound the immobility decisions of the respondents and interviewees.

Table 6.9: Individuals who wanted to migrate but did not do so

Distict	Yes	No	Refused to answer	
	N (%)	N (%)	N (%)	
All	182 (38.8)	285 (60.8)	2 (0.4)	$\chi^2 = 24.7648$ Pr = 0.006
Yilo Krobo	87 (37.8)	143 (62.2)	0 (0)	
Huhunya	19 (23.2)	63 (76.8)	0 (0)	
Obawale	33 (54.1)	28 (45.9)	0 (0)	
Akorley	35 (40.2)	52 (59.8)	0 (0)	
Wa West	95 (39.7)	142 (59.4)	2 (0.8)	
Siiru	27 (38.6)	43 (61.4)	0 (0)	
Dabo	34 (42)	45 (55.6)	2 (2.5)	
Siriyiri	34 (38.6)	54 (61.4)	0 (0)	
Ages				$\chi^2 = 46.0520$ Pr = 0.000
18 – 25	22 (56.4)	17 (43.6)	0 (0)	
26 – 35	64 (57.7)	47 (42.3)	0 (0)	
36 – 45	60 (39.5)	91 (59.9)	1 (0.7)	
46 – 55	22 (25.9)	62 (72.9)	1 (1.2)	
56+	14 (17.1)	68 (82.9)	0 (0)	
All	182 (38.8)	285 (60.8)	2 (0.4)	
Gender				$\chi^2 = 4.7391$ Pr = 0.094
Male	85 (35)	156 (64.2)	2 (0.8)	
Female	97 (42.9)	129 (57.1)	0 (0)	
All	182 (38.8)	285 (60.8)	2 (0.4)	

Source: Fieldwork, 2022

Table 6.9 shows data representing respondents who wanted to migrate but did not. Across regions, 38.8% of respondents wanted to migrate, but did not. When further differentiated by districts though a slightly higher percentage of respondents in the Wa West districts answered in the affirmative as compared to respondents in Yilo Krobo districts, both districts recorded a close range in percentage for respondents who wanted to migrate but did not, with Yilo Krobo representing 37.8% and the Wa West 39.7%. The results exhibited show that despite data from earlier sections (See Table 6.1), showing that climate related migration occurs in these areas, climate immobility equally exists in both districts. Regardless of the effects climate change has on their livelihoods, the above data expatiates that some rural household members might want to migrate but do not. Furthermore the close range in percentage between the two regions highlights how climate immobility is common in both regions despite the obvious difference in agro-ecological location.

Among the age groups, a larger percentage of respondents between the ages of 26-35 years old wanted to migrate but did not. This is followed by respondents between the ages of 18-25 years old. On the other hand, a smaller percentage of respondents in the age groups of, 36-45, 46-55 and 56+ years old answered in the affirmative. This is in line with findings of Van Praag (2021), which points out that older household members are likely not to aspire to migrate. This may range from personal reasons or the inability to get the necessary requirements. Again, some may have entertained the idea when they were younger, however, due to certain circumstances, they would rather stay behind, as they have grown older: An interviewee said the following during field interviews:

“Yes, I planned to migrate when I was in senior high school. I am a talented athlete and footballer. So, one of my uncles in Accra promised me that when I complete the school, he would look for s

football team for me to play. I also want to join the military of Ghana. But when I completed senior high school, the story has changed. My uncle did not keep his promise to look for a football team for me. My parents were also poor and they could not support me. I am a twin and I completed the senior high school with my brother. A year later our junior brother also completed. They could not support us in further our education to the tertiary level. That is why we are still here. By the grace of God, someone came to buy the land I am working on now and entrusted it to my care. So when I think of it, I would not want to migrate. Maybe some years ago but now it is not necessary”
(41-year-old male farmer, Akorley)

“For me I’m very okay. I don’t need to. My daughter sends me money every month. What would I have to go and do there? The city is too noisy and it smells. Here is very okay for me” (80 year old Male farmer, Dabo).

The above statement indicates that for the elderly, many deem it as a fruitless venture and have the preference to stay behind. Others like the interviewee from Akorley believe that time was no longer favourable to him. As confirmed by studies like Pemberton et al. (2021) and Zickgraf (2018), some may have settled due to age, and may have had well established social and family networks as well as insufficient funds to start over.

Consequently, in relation to gender, a larger percentage of women (42.9%) wanted to migrate but did not, this is in comparison with 35 % of the male respondents. This shows that a larger percentage of women wanted to migrate but did not in comparison with men. This is line with several mobility studies like (Ayeb-Karlsson, 2020; Boas et al., 2023; Tripathy et al., 2022), which asserts that more women are immobile than men. There may be several reasons for this trend, like existing cultural norms that restrict female mobility and honour male mobility (Rao et al., 2017).

For example being married may facilitate the movement of men, as their wives may be able to stay behind to cater for the children and elderly:

“...the wives take care of the family...so I can choose leave my wife and travel. Over here she can find something to do and sell. If I allow her to migrate what if someone is interested in her and you also understand how women are, very fragile...” (Youth FGD Siiru)

The above quote points out a key factor in women staying behind particularly in the Wa West district. Often when rural men cannot find employment opportunities in places of origin (Maharjan et al., 2020), they are compelled to migrate in search of jobs in other sectors. Their wives are tasked with staying behind to look after the family.

6.11 Causes of Immobility

The study further explored the causes of the immobility, to delineate the types of climate immobility, i.e voluntary and involuntary. In accordance to works such as as Zickgraf (2019), climate immobility is not a mono-causal phenomenon. Like climate related mobility, the conceptual underpinning of Foresight (2022) helps in understanding the nuances affiliated with the causes of climate immobility. According to Cundill et al. (2021), structures such as inadequate access to funds, government laws, family obligations and/or traditional gender roles are drivers of immobility. Though these factors maybe a driving force behind immobility, when they interact with environmental change they may cause climate-related immobility albeit not directly. For example, as noted in (Tripathy et al., 2022), some may remain immobile as a result of financial inadequacies which may not facilitate their migration ambition. These constraints may however be caused by poor crop yield, particularly in a rain-fed agriculture reliant households. Again, as indicated Schewel and Fransen (2022), despite the economic consequences of climate change on

the livelihoods of farmers some may use to voluntarily remain immobile as a result of place attachment, being happy in place of origin and or personal sentiments. This has again been supported by Carling and Schewel (2020) that some social groups may choose to remain voluntarily immobile due to family related reasons. In light of these multi-causal dimensions of climate related immobility, respondents in this study were given a list of options, which explained why they did not migrate. **Table 6.10**, indicates respondents' results.

Table 6.10 Main reasons for not migrating

	Could not get legal papers	Obligations at home	Waiting for the right opportunity	Lack of funds	Lack of contacts/network
	N (%)	N (%)	N (%)	N (%)	N (%)
All	1 (0.5)	72 (39.6)	36 (19.8)	48 (26.4)	16 (8.8)
Yilo Krobo	1 (1.1)	29 (33.3)	19 (21.8)	23 (26.4)	13 (14.9)
Huhunya	0 (0)	9 (47.4)	3 (15.8)	5 (26.3)	1 (5.3)
Obawale	1 (3)	11 (33.3)	4 (12.1)	12 (36.4)	5 (15.2)
Akorley	0 (0)	9 (25.7)	12 (34.3)	6 (17.1)	7 (20)
Wa West	0 (0)	43 (45.3)	17 (17.9)	25 (26.3)	3 (3.2)
Siiru	0 (0)	11 (40.7)	5 (18.5)	9 (33.3)	1 (3.7)
Dabo	0 (0)	20 (58.8)	4 (11.8)	8 (23.5)	1 (2.9)
Siriyiri	0 (0)	12 (35.3)	8 (23.5)	8 (23.5)	1 (2.9)
Ages					
18 – 25	0 (0)	6 (27.3)	6 (27.3)	8 (36.4)	0 (0)
26 – 35	1 (1.6)	18 (28.1)	21 (32.8)	14 (21.9)	7 (10.9)

36 – 45	0 (0)	30 (50)	8 (13.3)	14 (23.3)	6 (10)
46 – 55	0 (0)	12 (54.5)	0 (0)	6 (27.3)	3 (13.6)
56+	0 (0)	6 (42.9)	1 (7.1)	6 (42.9)	0 (0)
All	1 (0.5)	72 (39.6)	36 (19.8)	48 (26.4)	16 (8.8)
Gender					
Male	1 (1.2)	21 (24.7)	22 (25.9)	29 (34.1)	9 (10.6)
Female	0 (0)	51 (52.6)	14 (14.4)	19 (19.6)	7 (7.2)
All	1 (0.5)	72 (39.6)	36 (19.8)	48 (26.4)	16 (8.8)

Source: Fieldwork

Table 6.10 shows that, across regions a larger percentage (39.6%) stated obligations at home as a reason for not migrating, this was followed by 26.4% and 19.8% respectively stating a lack of funds and waiting for the right opportunity as a reason. This indicates that across regions a larger percentage was voluntarily immobile as compared to those who were involuntarily immobile. This proposes that despite the direct and indirect impact that climate change may have on individuals or on the livelihoods (Foresight, 2011), some choose to voluntarily stay behind as a result of family obligations. This corroborates Schewel (2020), whereby some non-migrants choose to stay behind regardless of available means to travel as a result of family-related reasons. Furthermore, according to the aforementioned data, it was revealed that some individuals refrained from migrating due to insufficient funds. This aligns with previous studies conducted by Black & Collyer (2014) and Carling (2002), which emphasize that involuntary immobility driven by climate factors often arises from the constraints of limited financial resources.

When spatially differentiated by districts, a larger percentage of respondents in the Wa West (45.3%) stated obligations at home as a reason for not migrating as compared to 33.3% of the respondents in Yilo Krobo. On the other, there is a close number in percentages between the two districts (26.4%, Yilo Krobo and 26.3% Wa West). The results demonstrate that despite being located in a harsher and poorer climate, a higher number of respondents in the Wa West district were voluntarily immobile as compared to the Yilo Krobo. The statement below may explain what accounts for the difference:

“I have to take care of some of my relatives. Other relatives have moved to the city but I decided to be the one to look after them. It is not really a problem. There might not be good crop yields like before, take last year for instance the yields were very bad but I have something going for myself. I can go and sell food for some of the workers. When my uncle send some money I use it to balance the household income...I do not mind migrating but I think that I can do just fine for myself without going through the hustle. I can take some sewing lessons being provided by the beauty pageant winner” (35 year old woman Siriyiri).

Across age groups, 39.6% stated that obligations at home was a reason they stay behind, 26.4% stated lack of funds and 19.8 % stated that they were waiting for the right opportunity. When differentiated by the various age groups, a large percentage of respondents in the age groups of 36-45, 46-55 and 56+ years stayed as a result of obligations at home. This confirms of (Zickgraf, 2018) who postulate that the older population are much more likely to stay behind as a result of family obligations. Often, members within these age groups have already began to have families; hence, kinship and family ties encourage them to stay (Schewel & Fransen, 2022; Zickgraf, 2018). On the other hand, 42.9% and 36.9% of respondents of the age groups 56+ and 18-25 years old stated a lack of funds. This supports the notion that the youth and the elderly are likely to be unable

to migrate as a result of financial constraints (Cundill et al., 2021; Wyngaarden et al., 2023). This is probably due to the fact that the youth maybe too young to have gathered enough finances to be able to support migration, whereas the old may have already settled down and have ran out of funds to finance their migration ambitions (Van Praag, 2021).

Gender wise, 34.1% of males did not migrate due to a lack of funds, 25.9% of were waiting for the right opportunity and 24.7% did not migrate due to obligations at home. On the other hand, 19.6% of females did not migrate due to adequate funds, followed by 14.4% who were waiting for the right opportunity. A larger percentage of females 52.6% did not migrate because of obligations at home. The above mentioned results demonstrates that a larger percentage of women were voluntarily immobile and have chosen to stay due to family obligations kinship ties and social and familial relations in comparison to a larger percentage of male migrants who were involuntarily immobile as a result of financial constraints. This result reaffirms (Boas et al., 2023; Schewel and Fransen, 2022; Tripathy et al., 2022) findings some households are often voluntarily mobile due to familial ties and attachment and involuntarily immobile due to financial constraints. In the context of this study, women were voluntarily mobile whereas the male were involuntarily immobile.

Nonetheless, additional in-depth interviews and FGD analysis show that obligations at home are often differentiated by gender and space. For instance, for most women, due to gender roles, obligations at home in both districts meant taking care of children or the elderly. Additionally, some women wanted to migrate but got pregnant hence compounding already existing obligations:

“...The male youth find it easier to migrate more than the female youth because some of the females become pregnant by the time they complete junior high school, and they are not able to

migrate to further their education. The boys migrate to further their education or be apprentices to learn a skill...” (Youth FGD, Akorley)

“Some of us women are not able to migrate because we have younger children that need our care. We do not have someone to take care of them and send them to schools. Also, our husbands would not approve if we want to migrate...” (Female Fgd, Obawale)

For others, in Wa West district, their husbands will not permit them:

“Yes, I would love to migrate but my husband will not permit me. Since he is the breadwinner for the household, I do not have to worry myself too much when he is able to provide for us.” (28-year-old female, Siiru)

Consequently, in-depth interviews further also revealed that though men’s obligations at home included taking care of the elderly, for most, it was because they were scared that their wives might be taken by another man in the community if they migrated:

“...I am scared. Not that I don’t trust her. But we hear several stories of unfaithful wives who cheat on their husbands when they are away. Some get pregnant and pretend that it is for their husbands. You will just end up looking after someone’s child who is not yours. I was away for sometimes. All that while, I was scared. Every second I called her. I thought about it and realised that it was not worth it...” (Returned migrant, Siriyiri)

For others, like in Yilo Krobo district, due to traditional gender norms men who stayed behind due to family obligations had to look after the households and farmlands. Some were conferred as the head of their families, this meant that they were obliged with representing the family on all front.

The quotes below from an in-depth interview and FGD sheds light on this phenomenon:

“...Yes, I understand where you are coming from. But if my son migrates who will look after the farms. Now labour is expensive. If he goes and the farmlands are abandoned it means that I have abandoned the land my ancestors gave me. Do you understand? He can even get a woman and marry here. But my daughters can go out and marry someone else. It doesn't matter but the legacy must remain here... sometimes my daughter's husband sends some money. So, you see it not bad...” (75-year old farmer, Huhunya)

“When a man becomes the head of the family, it becomes difficult for him to leave home. He becomes a unifying figure for his family and as such it becomes very difficult to migrate. Sometime, someone could have already migrated but when he becomes the head of the family as a result of the death his elders, he needs to come home” (Male FGD Huhunya)

It is worth mentioning that though statistical data does point out that men were involuntarily immobile due to financial constraints. It is important to note that, field interviews in the Yilo Krobo showed that it is similar to the Wa West district, by following a patriarchal structure, the traditional cultural norms in Yilo Krobo primarily limited the mobility of men and assigned them the responsibility of household care, whereas, migration was encouraged for women. This is in contrast to the Wa West. Nevertheless, it is crucial to acknowledge that these cultural norms in the Yilo Krobo not only restricted men from migrating but also provided them with certain privileges. According to Adger (2003), these privileges include rights to land ownership and resource inheritance, which are denied to women.

The data also showed that some respondents are waiting for the right time to migrate:

“I am planning to go to Accra. When the opportunity comes, I will go. I have contacted some friends who are already there and they promised me that when they get a job for me, they will

invite me immediately. So, if I get a call from them now, I am gone” (Respondent 2 Female FGD Obawale)

An interviewee of the same FGD had the following to say:

“Me too if I get the opportunity I will migrate. Even if I do not get the opportunity, I have decided not to marry and stay in this community. I will marry someone who is outside this area. I may consider marrying someone from this community who has migrated so that I will join him at his destination” (Respondents Female FGD Obawale)

For the men, many did not migrate as a result of inadequate funding, some however through their agency such as engaging in off-farm jobs gathered some funds. Despite this, they often had to utilize the money to look after the farm hence squashing their dreams:

“Many of the men also do not have money but they have the strength to do many of the farm work, what they do is that they serve as labourer on a bigger farm to earn money to be able to migrate. But sometimes the money ends up used for fertilizer...” (78-year-old woman, Siirru)

For some men, they believed they lacked funds and currently thought that their time had passed and would rather focus on family:

“Yes, many of us would want to migrate but there was no money we now have family obligations, we are married and our time has passed. I cannot move out this time if I am not guarantee of an income that will be enough to cater for my household. This is because; I would not like to migrate to another farming community. If I get the opportunity I will migrate with my household to the Tema and the cost of living there is extremely high. Now, my plan is to support my children to further their education, get white colour jobs and migrate from this community because they are

my social security in the future. I will depend on their remittances as pension in my old age” (47-year-old farmer, Huhunya)

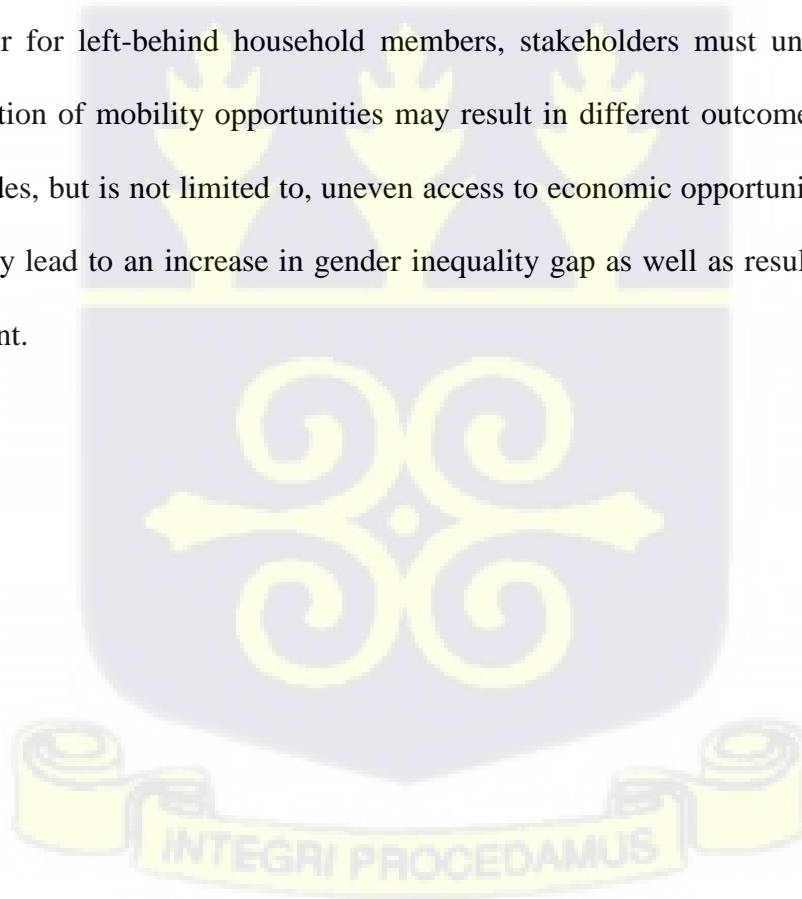
6.12 Conclusions

As a means to diversify household livelihoods, many rural households have adopted migration as an adaptation strategy. This was done in order to use remittances to absorb shocks that may emerge as a result of climate change effects. Collectively data analysed in this study shows that 71.3% of respondents in Yilo Krobo and 71.5% of respondents in Wa West had migrant households. While both districts may be located in different agro-ecological zones as well as have varying socio-economic structure, they both have about 70% of migrants. The close range in percentages of migrants in both districts may be attributed to economic opportunities (**See Table 6.2**). In which 41.3% and 19.91% of respondents across both districts migrated because of employment opportunities at the destination and the lack of work at the place of origin. Though climate change was not a direct cause of migration in this study, interviews with key informants and FGDs revealed that climate change effects on crop yields affects the ability of these individuals to sustain their livelihoods. Findings further showed that, in regard to age, a large proportion of the youth population, i.e 79.5% of respondents between the ages of 18-25 years had migrated, this finding reaffirmed studies carried out by (Schewel& Fransen, 2022). Gender-wise more women had migrated than men. This result contradicts findings such as those by Cundill et al. (2021) and Rao et al. (2017), which state that more men than women from Ghana are more likely to migrate due to employment opportunities at their destinations. In-depth interviews indicated that, this contradiction in findings may be attributed to severe economic stress and the need for both men and women to go in search of jobs. Yet though a larger percentage of migrants had migrated due to economic incentives, in-depth-interviews and FGDs shed light on how climate change effects

like drought interacted with underlying factors like economic stressors thereby motivating members to migrate (Ofori et al., 2023). These finding confirms Foresight (2011) which argues that environmental change does not directly cause migration. In the context of this finding, the effects of climate change on crop yields have an impact on farmers' income, which tends to affect the availability of jobs for farm labourers and other workers on the production line. Therefore, there was a scarcity of work at the place of origin prompting them seek for job opportunity elsewhere.

Statistical data from this chapter further showed that there are gendered dynamics in the migration patterns of both districts, whereby 70.8% of men migrated as compared to 72.8% women. Though these are close in figures, it purports that more a significant proportion of women and men are migrating this in contrast to Ghana migration literature which suggests that men are leading in the migration front (Jarawura and Smith, 2015). Works like Alatinga (2019), make an excellent case for the feminization of migration, whereby women in recent times have been encouraged to migrate despite existing structural constraints like patriarchal norms. However, field interviews from the study adds further nuance to the concept, by highlighting the traditional migration norms for women in the Yilo Krobo district. It shows that in contrast to the Wa West district, it is more common for women in the Yilo Krobo to migrate whereas the men were usually asked to stay behind. Therefore, contrary to the generally upheld belief on the nature of women's migration in Ghana, this chapter introduces the idea that patriarchal structure in the Yilo Krobo district encourages women particularly single women to migrate. This contradicts earlier migration studies undertaken in places like the Northern Ghana which infers that men are encouraged to migrate and women asked to stay behind.

Findings from this chapter further highlights that there are significant gendered differences in climate immobility in both districts under study. These differences are attributed to family obligations, the interaction of climate stressors like drought with economic structures and cultural norms. However the impact of these factors were gendered as the statistical data espoused by field interviews and FGDs indicated that contrary to earlier studies which purported women to be involuntarily immobile, in this study women were voluntary immobile, as compared to men who were involuntary immobile. Acknowledging and understanding the existence of these gendered differences in climate immobility will enable both researchers and policymakers to gain an extra insight into the socio-economic dynamics nature of these regions. For example, in order to develop a policy to cater for left-behind household members, stakeholders must understand how the unequal distribution of mobility opportunities may result in different outcomes for women and men. This includes, but is not limited to, uneven access to economic opportunities and resources network that may lead to an increase in gender inequality gap as well as result in unsustainable rural development.



CHAPTER SEVEN

CONCLUSION, SUMMARY, RECOMMENDATIONS

7.1 Introduction

This study examined the spatial and gendered dynamics of climate adaptive capacity and climate-related (im) mobility in the Upper West and Eastern regions of Ghana. To achieve this goal, the study initially focused on understanding the perception of climate change among rural farmers in both regions. This analysis aimed to determine how climate change was perceived among various social groups in the Northern Savannah and forest zones, and to ascertain whether these perceptions aligned with scientific data and influenced adaptation strategies. While previous studies in Ghana have explored factors such as financial access and traditional inheritance systems influencing farmers' adoption of adaptation strategies, these investigations have primarily focused on the Northern Savannah zone. Therefore, it is equally important to understand how farmers' perceptions of climate change inform their choices of adaptation strategies. Additionally, as the study examined the adoption of in-situ adaptation strategies, it sought to explore the extent to which households in the two districts under investigation utilized migration as an adaptation strategy. This analysis was crucial for understanding how remittances from migrants could act as a form of vulnerability reduction for households facing the effects of climate change. However, despite the potential benefits of migration, some household members expressed a desire to migrate but were unable to do so due to personal decisions or structural constraints. As a result of this, the study aimed to determine if there were gendered differences in climate-related immobility in these districts.

This chapter serves as the concluding chapter, providing a summary of the findings, policy recommendations, and conclusions derived from the study.

7.2 Local People's Perception with Climate Change

The study revealed that across the two districts, majority of respondents had witnessed forms of climate change variations such as an increase in temperature, decrease in the amount of rainfall and manifestations of extreme fluctuations of rainfall distributions. The level of perception however varied among men and women, various age groups, as well as respondents with different levels education.

Although, farmers' perception in both regions were consistent with what the metrological services purported, there were certain unexpected variations in perceptions that were dissimilar with available literature. For instance, most literature on perception studies show that people with higher level of education were more likely to perceive climate change variations (Asare-Nuamah & Botchway 2019; Soubry et al., 2020). In contrast, this study showed that a higher percentage of respondents with no formal education and in some instances primary level education perceived climate change variations. The researcher realized that a probable cause for this dissimilarity with other research works undertaken would be due to fact that many Ghanaian local farmers have little to no education.

In regard to age, studies such as Fahad and Wang, et al. (2020) highlight that, younger farmers are more likely to have a higher perception of climate change than older farmers. Though the quantitative data confirmed this tendency, qualitative data analysis demonstrated that older farmers were equally attuned to the variations of climate change due to their experience in farming. It also revealed that among older farmers perception of climate change were based on a longer length of

stay in the communities as compared to the younger farmers. Also, as they got older, it was easier to remember the state of the climate in the past and compare it to the current. In addition, experiences gathered over the years by older farmers enabled them to easily determine the effects of climate change on their livelihoods through various time periods.

In relation to gender, analysed data showed that both men and women experienced climate change variations. However, more women than men perceived an increase in temperature. The chi square test showed that there is a significant gendered difference in farmer' perceptions of temperature change, rainfall patterns and distribution. The differences in perception can be attributed to the variances in traditional gender norms in the rural both districts. Conversely, these perceptions were spatially differentiated among districts, among gender and within gender. In most instances, respondents in Wa West district had a higher perception of temperature increase than those in Yilo Krobo. The researcher believes that this may be as a result of the district's location in the Northern Savannah zone. As a result of this, farmers in Wa West district were exposed to a much harsher and more arid conditions and were more likely to perceive an increase in temperature. Consequently, a higher percentage of women in Wa West perceived an increase in temperature as compared to women in Yilo Krobo. Regarding rainfall distribution, a high percentage of respondents across both regions believed that rainfall had decreased; this was congruent with the metrological data depicted in **Figure 2.1** and **2.2**.

The researcher believes that the above finding does not only highlight the various gendered and spatial differences in climate change perceptions across the two districts, it also challenges extension officers to efficiently address and effectively communicate adaptation strategies to local farmers. The researcher also believes that understanding the gender and spatial disparity of climate change perceptions will enable policymakers to gain a better spatiotemporal understanding of local

farmers' perceptions and experiences. This will aid in the creating better and tailored information flow to diverse rural farmers across the two districts. This finding also highlights the need for policymakers to recognize how gendered perceptions on climate change inform the numerous adaptation strategies and adaptive capacity of different social groups. As established by earlier studies (e.g. Kidido et al., 2019; Jost et al., 2016; Perez et al., 2015), most farming communities are impacted by male dominated traditional customs and norms. The researcher further believes that understanding the gender disparity pertaining to farmers perceptions of climate change will serve as a guideline on how to discourage the negative effect that male dominated gender norms has on rural female farmers. This would further aid in the promotion of equal access as well as enforcing tailored climate change intervention programmes in the various communities and among the social groups.

7.3 Gendered and Spatial dynamics of Climate Change Adaptation Strategies in the Upper West and Eastern Regions of Ghana

The findings from this study illustrated the multidimensional nature of climate change resilience in both districts. The strategies adopted by farmers across the regions, included soil conservation techniques such as; steps taken against soil erosion, adoption of less farmlands and use of fertilizers and irrigation. Some equally engaged in agro-economic practices such as; adoption of newly improved crop varieties, changes in planting time as well as, use of machinery. Additionally, there were some farmers that adopted diversification of livelihoods through strategies such as adoption of non-agricultural work, production of handicrafts, maintenance of fewer livestock and reduction in expenses.

Conclusions from analysis showed that there were significant gendered and spatial dynamics between the two districts due to structures such as traditional gender norms, traditional inheritance systems, their location, climatic conditions, landscape and the availability of resources. In the Wa West district for example, local farmers grappled with erratic rainfall and prolonged dry season hence irrigation was adopted in a greater percentage as compared to the Yilo Krobo district. Additionally, focus group discussions as well as in-depth interviews from the two districts revealed that the Wa West district had a greater access to resources either funded by the government or NGOs as compared to the Yilo Krobo district. This reflected a concept known as entitlement failure (Teye and Owusu, 2015), which demonstrated the inadequacy of government policies in the Yilo Krobo district where some farmers did not have access to the necessary resources to adopt an adaptation strategy. Admittedly, the researcher acknowledges that the Wa West district is considered one of the poorest regions in Ghana and has a heavy reliance on rain-fed agriculture and this makes it much more vulnerable to poverty as a result of climate change/variability. Despite this, what stood out to the researcher was that the farmers from the Yilo Krobo district were equally susceptible to the negative effects of climate variation yet FGDs and in-depth interview revealed that there was no comprehensive input from the government. Many farmers believed that this was as a result of the erroneous notion by stakeholders that farmers in the Yilo Krobo district did not have to deal with the effects of climate change. This highlighted a very important fact that local farmers' perception of climate change was not the only prerequisite in designing policies. It was also of equal importance that the stakeholder's perception of climate change did not only align with scientific data but that of local farmers since this would ensure an efficient and effective design of planned adaptation strategies.

Regarding gender, except for changes in planting time, reduction in expenses, and engaging in non-agricultural work, the majority of male farmers were found to adopt the adaptation strategies in this study. The chi-square test conducted on each strategy revealed a significant gendered difference in farmers' adoption of adaptation strategies. Thematic analysis further revealed that the gendered dynamics of in-situ adaptation strategies influenced various rural farmers' access to decision-making, resources, and labor allocation. For instance, rural women in this study were held back from taking active decisions or accessing adequate financial resources as a result traditional norms which mandated them to take care of the family and household chores. This prevented them from efficiently adopting a strategy. On the other hand, rural male farmers tend to benefit from various privileges which stems from cultural structures, such as land ownership and resource inheritance. This shifted the power dynamic in their favor, hence affecting their decision-making capabilities in adaptation practices. In addition, logistic regression analysis, indicated that for certain strategies, factors such as gender, age, level of education, length of stay in the community, and participation in CSA programs statistically influenced whether a farmer was more inclined to adopt a strategy or not. However, it is important to note that these significant factors worked alongside contextual variables including financial capabilities, information flow, and youth capability (Yaro et al., 2016).

This outcome emphasizes the need to take into consideration the diversity of social groups, as well as demonstrates the need for climate change interventions to be inclusive. It further indicates the importance for stakeholders to strive for a fair and balanced allocation of intervention programs in all districts, whilst urging for a localized gender equality access to resources. Therefore, in order to efficiently address the spatial and gendered dynamics of in-situ adaptation strategies of both districts, local and national level stakeholders need to promote a gender equality discourse, by

implementing laws that will give women equal access to resources while simultaneously empowering women to take part in the decision-making process. This can be done by ensuring that training programs do not coincide with the general times for women's household chores. In addition, farmers particularly women should be supported with accessible and collateral free financial resources, localized technical knowledge, as well as infrastructure in order to stimulate and encourage them to adopt ecological friendly adaptation practices. There should also be an alliance between local communities, government agencies, and non-governmental organizations as well as both men and women in order to streamline information flow that will improve climate resilience and foster long term sustainable livelihoods for farmers in the two districts. Using the theoretical lens of structuration theory (Giddens 1984) and entitlement framework (Adger, 2003; Leach et al., 1999; Teye and Owusu, 2015) to shed light on the structural constraints as well as entitlement failure emanating from poor government policies, it is argued farmers adoption of efficient strategies was poor.

7.4 Climate related im(mobility) in the Upper West and Eastern Regions of Ghana

There are similarity in migration patterns in both districts demonstrating that migration is quite popular across both districts despite being located in different agro ecological zones. Further data analysis indicates that there is a generational dynamic in migration patterns. It shows that 79.5% of migrants are between the ages of 18-25 years. This implies a potential rise in elderly communities members left behind. When differentiated by gender, a larger percentage of women had migrated than men. The aforementioned outcome of the study underscores that the extent to which households across the two regions has adopted migration as an adaptation strategy is dependent on an array of factors. For instance, in the case of the Wa West district unstructured rainfall patterns and distributions as well as a long dry season led to limited resources and job

opportunities. This meant that most households found migration as a much-needed adaptation strategy in order to have a better livelihood. Earlier literature works such as (Abdul-Korah, 2008; Yendaw et al., 2016) had espoused that the migration patterns of male household members in the Wa West were influenced by better economic opportunities in other area, whereas for the women it was influenced by social factors like marriage and education. Though found to be true in this study, the researcher found out through in-depth interviews and FGDs that due to very harsh economic condition women in the Wa West districts were asked to migrate to search for better livelihoods. This was further fueled by the notion that women often remitted regularly than men. Nevertheless, there were some cultural constraints women in the Wa West faced, like seeking permission from male family members before migrating.

On the other hand, in the Yilo Krobo the data showed that migration patterns were influenced by the lack of jobs opportunities at the origin and better economic opportunities at destinations. Though economic factors influenced one's reason for migration, probing during in-depth interviews revealed that it was as result of the indirect consequence of climate change effects on the livelihoods. This finding converges with the foresight framework, reinforcing the idea that migration is not a direct effect of climate change but as a result of environmental factors interacting with structures like economic factors (Foresight, 2011).

The study further indicated that there were gendered differences in the climate immobility in both districts. Despite the effects of climate change on households' livelihoods, migration was not adopted by all. Research findings suggest that this was as a result of factors such as inadequate financial resources, family obligations and in some instances waiting for the right time. Furthermore, the study indicated that women were voluntarily mobile due to family obligations whereas men were involuntarily immobile due to financial constraints. Nonetheless, in contrast to

earlier and recent findings in the Upper West (Anarfi et al., 2003; Hofstede, 2020; Isaac and Raqib, 2013), excerpts from in-depth interviews and FGDs demonstrate that traditional gender norms in the Yilo Krobo district enforced restrictions on male migration, and, in turn, promoted female migration. It was therefore much common for men in Yilo Krobo to stay behind care for family matters, while single women were tasked with migrating to urban centres for marriage and economic opportunities. This finding raises questions on how male non-migrants affect the socio-economic dynamic of the district. It also causes one to probe on how the household and family dynamics are challenged with the migration of single women.

These results demonstrate that the spatial and gendered dynamics of migration in the two districts were determined by access to financial resources as well as traditional gender roles and responsibilities. It also shows that uneven access to mobility opportunities leads to varying outcome for men and women. In order to avert this, policymakers must create avenues that will challenge traditional gender norms restricting the mobility of both men and women. Likewise there must be equal access to information resources in order to empower migrants undertaking the migration decision process. Additionally, this result highlights the need for stakeholders as well as researchers to advocate for gender inclusive programs for left behind non-migrants.

7.5 Conclusions

Climate change does not impact places and people equally. As a result, some social groups experience more severe consequences and this impacts their livelihood. Both genders perceive changes in temperature as well as rainfall patterns and distributions. Such changes and awareness of the climate change impact on farm yields and hence prompt farmers to adopt certain adaptation

strategies. However, the adoption of these strategies is either constrained or enabled by cultural, economic, social or political factors.

There were significant gendered and spatial dynamics in the adoption of in-situ adaptation strategies. Economic structures, traditional gender norms as well as access to information and resources had important impacts on the use of adaptation strategies. For example, the uneven distribution of government resources to places like the Yilo Krobo limited the adaptive capacity of farmers.

Most households used migration as an adaptation strategy. Likewise, many used remittances to absorb shocks emerging from climate change effects. As echoed by the Foresight framework, most migrated due to the interaction of climate change with underlying economic stressors. In relation to gender, both men and women across districts migrated, though their motivations and patterns were dissimilar. In addition, although there has been an ongoing increase in female migrants in the Wa West district, field interviews from Yilo Krobo revealed that women had always been encouraged to migrate whereas the men were asked to stay behind as part of their duties. Consequently, further analysis showed that both men and women were probable to experience climate immobility, but that the causes varied. This study shows that most women were voluntarily immobile due to family obligations whereas the men were involuntarily immobile due to financial constraints. This result has implications on the way that migration is understood in other cultures and places, particularly in Ghana. Often it is presumed that traditional structures constrain the movement of women, hence policies, training programmes and empowerment schemes are designed based on this narrative. The finding in this study thus challenges the pre-existing narrative on the gender dimensions of mobility in Ghana whilst equally encouraging the inclusivity of men in training programmes for left behind non-migrants. It further complements the mobility literature

in Ghana by creating a unique insight into how the patriarchal structures in the Yilo Krobo limit the mobility yet paradoxically gave men privileges to access resources.

In conclusion, this study contributes to the already existing literature on climate change, gender and migration in Ghana, particularly in the Eastern and Wa West districts of Ghana. It accentuates the need for a context-specific spatio-gender responsive approach to climate change adaptation and migration policies, by acknowledging the varying vulnerabilities and challenges experienced by various social groups in different agro-ecological zones. Furthermore, it gives a different perspective on climate immobility in Ghana and creates room to reinvent what has been understood about climate-related mobility in Ghana.

Additionally it calls for a need for researchers to further explore the various dimensions that exists between climate change, gender and migration under different agro-ecological context in Ghana. The researcher has the conviction that by acknowledging and deepening our understanding of the existence of the complexities between climate change, gender and migration, policy makers, researchers as well as development agencies can design inclusive strategies to address climate change impacts and promote sustainable development.

7.6 Recommendations

The following recommendations emanate from this study:

There is an apparent disconnection between the perceptions of key stakeholders in the government institutions and that of local farmers. By implication, most climate change interventions are primarily focused on places like the Northern Savannah Zone, relegating places like the forest zone to the background. Climate change intervention programmes can be effectively implemented and distributed in Ghana by bridging the perception gaps between stakeholders like the Ministry of

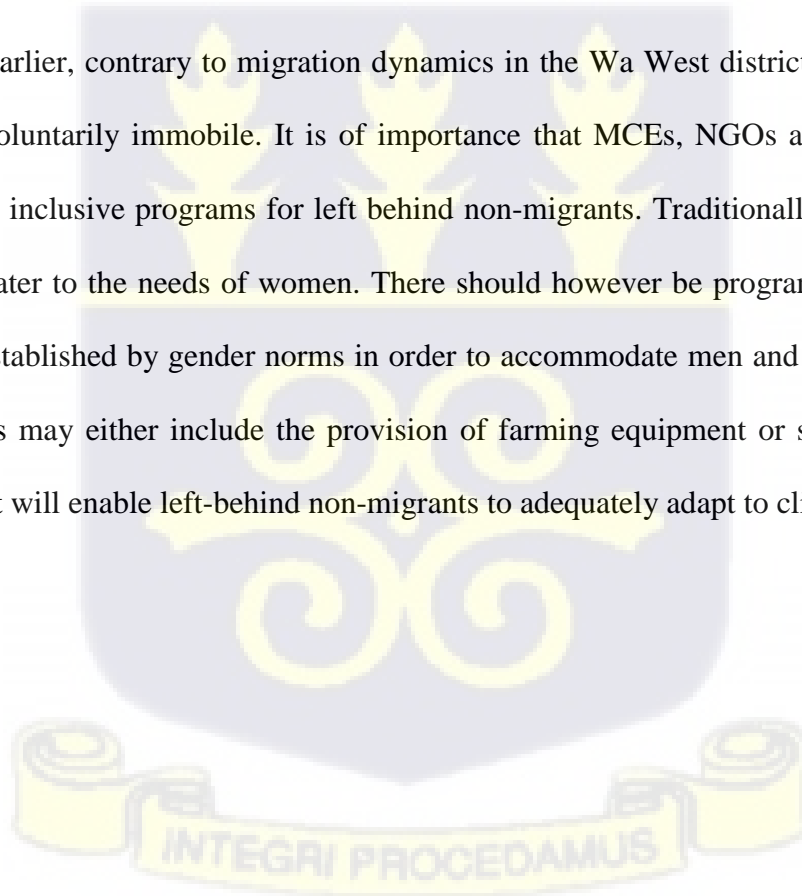
Food and Agriculture and the Ministry of Environment, Science Technology and Innovation (MESTI), policy makers like the National Climate Change Committee (NCCC) and local farmers. Additionally, localized and context specific agriculture information must be streamlined to farmers. This can be done by organizing dissemination workshops involving stakeholders (like the above mentioned), rural farmers, members from the academic community such as the Institute for Environment and Sanitation Studies (IESS) of the University of Ghana, traditional rulers and the metrological agencies. This will ensure that all parties are updated with current climatic data and further reinforce the relationship between indigenous and scientific knowledge

It is imperative that the Ministry of Food and Agriculture liaise with financial institutions to provide women farmers with collateral free credit to finance the acquisition of farming inputs such as improved seed varieties, tractor services and fertilizer. Furthermore, agriculture extension officers and agriculture based NGOs will need to show local farmers the proper usage of agrochemicals as well as the right use of hard machinery, this is because the improper usage could pose health risk to human life as well as cause a disruption of the ecosystem.

Gender sensitive and training programmes should be carried out in study communities. This may be designed after a correspondence between local farmers, particularly female farmers, agriculture related NGOs, traditional rulers and extension officers. This will not only ensure that women farmers are included in the designing and implementation of adaptation strategies. It will further ensure that agriculture extension training programmes are designed to fit into the schedule of rural female farmers. In addition, Civil Society Organizations (CSOs) should aid and advocate for gender equality in resource ownership and control through affirmative actions and women empowerment programmes as well as educating male farmers and traditional leaders the importance of supporting women to acquire and own resources.

There is the need for the Ministry of Local Government and Rural Development (MLGRD) to rehabilitate old factories in order to create more off-farm jobs for farmers who want to diversify their household income. Rehabilitating and renewing old factories would mean that there would be more means for farmers to diversify livelihoods. This would create more jobs for younger farmers, whilst reducing the number of migrants who move as a result potential economic opportunities in destination. Additionally, storage house for crops should be established in order to reduce the loss of farmers' income due to crop failure. This would enable farmers to have a surety in the provision of food for their household as well as a means to gain income from the sale of their stored food.

As established earlier, contrary to migration dynamics in the Wa West district, men in the Yilo Krobo were involuntarily immobile. It is of importance that MCEs, NGOs and CSOs develop localized gender inclusive programs for left behind non-migrants. Traditionally, these programs are tailored to cater to the needs of women. There should however be programs that will break down barriers established by gender norms in order to accommodate men and people of various age groups. This may either include the provision of farming equipment or skill improvement programmes that will enable left-behind non-migrants to adequately adapt to climate change.



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APPENDICES

Appendix 1: Questionnaire for the survey

CLIMATE CHANGE, GENDER AND MIGRATION IN THE UPPER WEST AND EASTERN REGIONS OF GHANA

Introduction

This survey is being conducted as part of a study on climate change, gender and mobility practices in the Upper West and Eastern regions of Ghana. Your responses will be used anonymously and only for academic research purposes.

Instruction:

One person, a male or a female should complete the questionnaire. Ensure that at least 50 percent of respondents are females.

Circle codes or answers in spaces provided.

A. Background Characteristics and Assets

1. Settlement Name:.....Settlement Code:
2. Respondent Code:
3. Gender of respondent: (1) Male (ii) Female
4. Marital status of respondent (i). married (ii). single (iii). Divorced/Separated (iv). Cohabitation v. Other (specify)
5. Religion of respondent (i) Traditional (ii). Christian (iii) Muslim (iv). Other... Specify
6. Gender of your household head (i) Male (ii) Female
7. Age of respondent
8. Relation of respondent to household head:
(i) Household head (ii) Spouse (iii). Son/daughter (iv) Brother or sister to household head (v) other (specify)
9. How many years have you been living in this community?
(i) All my life (ii) 20 years or more (iii) 10 to 19 years (iv) less than 10 years

10. Education completed by the respondent:

- (i) No formal education (ii) Primary (iii) Junior Middle School (class 8-10)
(iv) Senior High School (Class 11-12)/'A'level (v) Vocational (vi) Tertiary

11. Main source of livelihood of respondent:

- (i) Crop farming (ii) Animal husbandry (iii) Fishing (iv) Land rents
(v) Trading/commerce (vi) Civil servant (vi)i Business employment
(viii) Skilled labour (mason, carpenter, mechanics..) (ix) Unskilled labour (x) Remittances
(xi) other (specify).....

12. Main occupation of household: (i) Crop farming (ii) Animal husbandry (iii) Fishing (iv) Land rents (v) Trading/commerce (vi) Civil servant (vi)i Business employment (viii) Skilled labour (mason, carpenter, mechanis..) (ix) Unskilled labour (x) Remittances (xi) other (specify).....

13. Additional sources of livelihoods:

- (i) Crop farming (ii) Animal husbandry (iii) Fishing (iv) Land rents
(v) Trading/commerce (vi) Civil servant (vi)i Business employment
(viii) Skilled labour (mason, carpenter, mechanis..) (ix) Unskilled labour (x) Remittances
(xi) other (specify).....

14. If you cultivate crops, indicate the types of crops you cultivate? (Multiple)

- (1) Rice (2) Maize (3) Millet (4) Sorghum (5) Groundnut (6) Soya bean (7) Cassava
(8) Yam (9) Beans / Cowpea (10) Bambara beans (11) Okra (12) Pepper (13) Water melon
(14) Mangoes (15) Tomato (16) Salad Vegetables (17) Cotton

15. Do you farm land?

Yes/No

- If yes: (i) On land you own (ii) Land owned by my spouse (iii) Contract
(iv) on forest land (v) on sharecropped land (VI) on family land
(v) on community land (VI) on land leased under fixed term

16. Do you own a farming land in this community? (i) Yes (ii) No

17. If yes how many acres of land do you own

18. Major items owned by you (Tick as many as applicable):

ASSETS	OWNED	RENTED/LEASED
1. House		
2. Working livestock (e.g. mule, horse, oxen)		
3. Cows		
4. Tractor		
5. Plough		
6. Television		
7. Radio		
8. Bicycle		
9. Motorcycle/two-wheeler		
10. Car/jeep		
11. Refrigerator		
12. Backpack hand sprayer		
13. Tricycle with load carrier		

19. Do you have a bank account? Yes / No

20. Do you have a mobile phone account that permits making payments?
Yes/No/NA

21. Do you borrow money from:

	Regularly	Occasionally	Never
Bank			
Local financial institution			
Private moneylender			
Family			
Friends			
Other, specify			

B. Knowledge and Perceptions of Climate Change and Variability

22. How would you describe the temperature in this area over the past 20 -30 years?

1. Increased 2. Decreased 3. No change 4. Don't know

23. How would you describe the amount of rainfall in this area over the past 20 -30 years

1. Increased 2. Decreased 3. No change 4. Don't know

24. How would you describe the pattern of rainfall in this area over the past 20 -30 years

1. Delayed onset 2. Early onset 3. Extreme fluctuations 4. Don't know

25. How would you describe the distribution of the rainfall during the farming season over the last 20 – 30 years

1. Regular 2. Irregular 3. Extreme fluctuations 4. No change 5. Don't know

26. In your view, is the climate in this area changing

1. Yes 2. No 3. Don't know

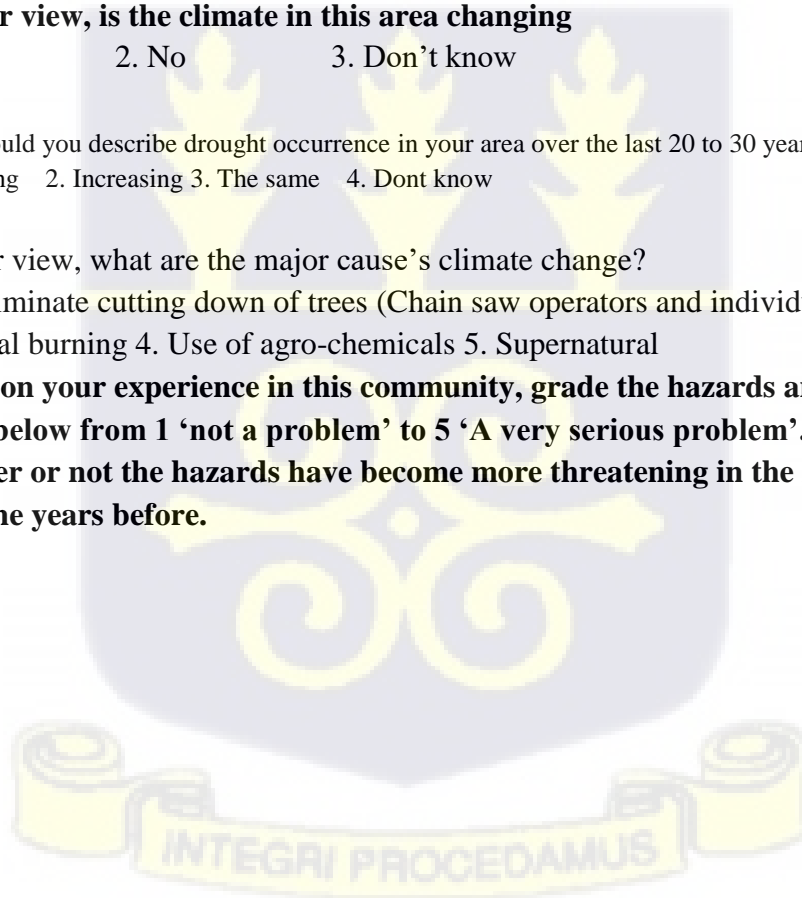
27. How would you describe drought occurrence in your area over the last 20 to 30 years?

1. Decreasing 2. Increasing 3. The same 4. Dont know

28. In your view, what are the major cause's climate change?

1. Indiscriminate cutting down of trees (Chain saw operators and individuals) 2. Bush fire
3. Charcoal burning 4. Use of agro-chemicals 5. Supernatural

29. Based on your experience in this community, grade the hazards and challenges given below from 1 'not a problem' to 5 'A very serious problem'. Also, indicate whether or not the hazards have become more threatening in the last 10 years than the years before.



Hazard	Mark with X if experienced within the past year	Rank	Is the hazard becoming more serious than past 10 years?	
			Yes	No
Drought				
Floods				
Rains irregular, insufficient or too heavy				
Extreme temperatures (high and/or low)				
Crop pests/diseases (fx locusts, rodents, birds, fungi, etc)				
Decreasing soil fertility				
Problems with input purchase (seeds, fertilizers, raw materials, etc.)				
Problems with output sales (agricultural, artisan, fish, dairy, etc products)				
Livestock diseases				
Lack of drinking water				
Illness affecting the household/family				
High food prices				
Lack of employment				
Problems with access to farming land				
Problems with access to forestry and Non-Timber Forest Products (NTFP)				
Conflicts over land (land grabbing)				
Conflicts over service provision (schools, health clinics, drinking water, electricity, etc.)				
Lack of government support to help with HH's problems				

30. What are the main effects of changes in temperature on your economic activities/livelihoods? Rank the 5 topmost responses with 1 being the most serious effect and 5 being the least serious effect

- (i) Declining crop yield (ii) declining income (iii) increased food insecurity (iv) increased water scarcity (v) increased incidence of crop pests and diseases (vi) emergence/worsening of human diseases (vii) increased stress load (viii) **increased work load**

31. What are the main effects of changes in rainfall on your economic activities/livelihoods? Rank the 5 topmost responses with 1 being the most serious effect and 5 being the least serious effect?

- (i) Declining crop yield (ii) declining income (iii) increased food insecurity (iv) increased water scarcity (v) increased incidence of crop pests and diseases (vi) emergence/worsening of human diseases (vii) increased stress load (viii) **increased work load**

32. What are the main effects of flooding on your economic activities/livelihoods? Rank the 5 topmost responses with 1 being the most serious effect and 5 being the least serious effect?

- (i) Declining crop yield (ii) declining income (iii) increased food insecurity (iv) increased water scarcity (v) increased incidence of crop pests and diseases (vi) emergence/worsening of human diseases (vii) increased stress load (viii) **increased work load**

C. CLIMATE ADAPTATION STRATEGIES

33. Have you personally undertaken any of the following to deal with climate change in the past 5 years? For each action, state whether it was able to help reduce the effects of hazards or not. If strategy was not adopted, can you explain why?

Adaptation Strategy for household (HH)	Strategy adopted? Yes/No/ not relevant	Did the strategy help reduce the hazard? Yes/No/ not relevant	If not, why did you not adopt this activity? (i) lack of finance (ii) lack of information (iii) it would not help (iv) The land is not owned by us (v) Other reason (<i>specify</i>)
Adoption of irrigation			
Farming less land			
Maintaining fewer livestock			
Adopting improved or new crop varieties			
Change time of planting			
Use more fertilizer and pesticide			
Use more machinery			
Take steps against soil erosion			
Buy crop/cattle insurance			
Seasonal migration (annually) to urban areas			
Migrated only sometimes to urban areas			
Seasonal migration (annually) to rural areas			
Migrated only sometimes to rural areas			
Short- or long-term migration abroad			
Start to produce handicrafts			
Look for non-agricultural work			
Begin trade in agricultural and other commodities			
Reduce expenses (e.g. type and number of meals)			
Seasonal migration (annually) of other household members to urban areas			
Seasonal migration (annually) of other household members to rural areas			
Permanent migration away from settlement by other HH members			

34. Has your household received help in the past specifically due to drought, flooding, poor/failed harvests, lack of food? Yes / No / Do not know.

35. Have you personally received help in the past specifically due to drought, flooding, poor/failed harvests, lack of food? Yes / No / Do not know

36. If Yes, where from and in what form:

Source of help	Form of help (i) Money (ii) Food (iii) Inputs (iv) Training (v) Other (specify)	Regularly	Occasionally	Never
Central or regional government				
Local government offices				
Local political leaders				
Traditional leaders				
Religious institutions (church/mosque, etc.)				
Family and friends				
Other (specify)				

37. Have you ever received any training on climate smart agriculture methods in the last ten years?

1. Yes 2. No

38. Which specific training were you given? [Tick all that apply]

1. Tillage 2. Mulching 3. Fertilizer 4. Indigenous seeds requiring low inputs
5. Climate resilient seed 6. Planting across / along slopes 7. Stone bunding
8. Manure 9. Other ... specify

39. 37. Have ever received any training on alternative income sources

1. Tailoring 2. Carpentry 3. Hardressing 4. Weaving 5. Pottery 6. Fish farming.
7. Mushroom farming 8. Grass cutter farming 9. Other

D. MIGRATION AND IMMOBILITY

40. Has any household member moved temporarily or permanently away in the last 10 years (since 2012)? (i) Yes (ii) No

41. If the answer to 42 is yes, complete the table below for each HH migrant

HH migrant (Household ID, start with 01 for first migrant)	Type of mobility: (i) Permanent abroad (5 years) (ii) Permanent in- country (5 years) (iii) Recurrent/short-term (iv) Daily commute work/school (v) Returned migration (vi) Other (state)	Current Age	Gender (i) Male (ii) Female	Destination (i) Capital of Ghana (ii) Another urban area in Ghana (iii) Rural settlement (iv) Abroad (specify)	Reasons for Migration (multiple allowed) (i) Education (ii) Marriage (iii) Employment opportunity at destination/look for opportunities (iv) Lack of farming land (v) Crop failure (vi) Lack of work here (vii) Floods (viii) Droughts (ix) Conflict/insecurity (x) Other (specify)
1					
2					
3					
4					
5					

42. Using the table below, indicate if each of the migrants has sent remittances to this household in the last 12 months?

Household migrant ID (Pre-selected)	Did migrant send food items to this household in	Did migrant send remittances to your household in the past 12 months?	How regularly does migrant send remittances to	Approximately how much money in total have you received from Name in the last

	the last 12 months?	1. Yes 2. No	this household?	12 months? (enter this in Cedis)
	1. Yes, weekly 2. Yes, monthly 3. Yes quarterly 4. Yes, Yearly 5. Never		1. Weekly 2. Monthly 3. Quarterly 4. Yearly 5. Not applicable	
1				
2				
3				
4				
5				



43. What is the money received from migrants mainly spent on (multiple choice – as an open question.

- (i) Food (ii) Education (iii) Health Care (iv) **Health Care** (v) Marriage/Funeral (vi) Farming – seeds/insecticides/irrigation (vii) Farming – livestock (viii) Land purchase (ix) House construction

44. Did you ever want to migrate from this community but did not do so?

- (i) Yes (ii) No (iii) Refuse to answer

45. State the reasons why you wanted to migrate.

- (I) Education (ii) Marriage (iii) Employment opportunity /look for opportunities (iv) Lack of farming land (v) Crop failure (VI) Lack of work here (vii) Floods (viii) Droughts (ix) Conflict/insecurity (x) other (specify)

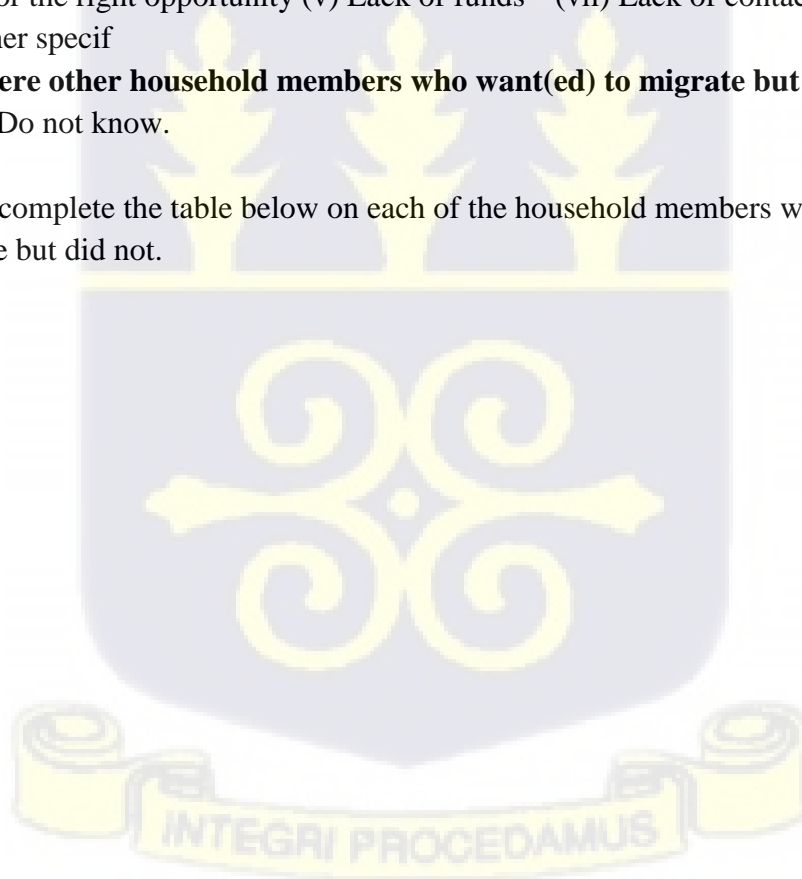
46. What was the main reason why you could not migrate?

- (i) Could not get legal papers (ii) Too dangerous/risky (iii) Obligations at home (iv) Waiting for the right opportunity (v) Lack of funds (vii) Lack of contacts/network (viii) Other specif

47. Are there other household members who want(ed) to migrate but did not?

Yes /No /Do not know.

48. If yes, complete the table below on each of the household members who wanted to migrate but did not.



COVID-19

49. Has anyone in your **migrants** come home to the household because of Covid-19?
Yes/No/ Do not know.

50. Has your household lost any of the following because of Covid-19?

HH member who wanted to migrate	Age today	Gender (i) Male (ii) Female	Reason why named wanted to migrate from community (multiple allowed) (i) Education (ii) Marriage (iii) Employment opportunity (iv) Hustling/look for opportunities (v) Scarcity farming land (vi) Failing production (vii) Lack of work here (viii) Floods (ix) Droughts (X) poor rainfall (xi) poor soil fertility (x) Conflict/insecurity Other (specify)	What was the main reason for which named could not migrate? (i) Could not get legal papers (ii) Too dangerous/risky (iii) Obligations at home (iv) Waiting for the right opportunity (v) Lack of funds (vii) Lack of contacts/network (viii) I am too attached to this community
1				
2				
3				
4				
5				

	Yes	No	Not relevant
Loss of remittances			
Loss of farming income			
Loss of income from employment			
Loss of income from market sales			
Loss of income from handicrafts			
Loss of income from service work			

53. Do you have intention to migrate in the future?

1. Yes 2. No

54. Where do you intend to go?

1. outside the continent 2. Southern Ghana 3 within northern Ghana 4. Outside Ghana but within Africa

55. Respondent Number (Optional)



Appendix 2: Guide for focus group discussions

1. Community background

1. Can you tell me about the history of your community in regards to climate-induced migration?

- Probe for social group likely to migrate including level of education, age and sex of each household member?
- Probe the main economic activity of community members. Probe which economic activity is popular within each social group.

2. Tell me about how community members make a living currently make a living.

- What livelihoods do male and female members of the community engage in?
- Do male and female members of this community have equal access to resources needed farming (e.g., land, labour, capital, fertilizer)? Probe reasons for any gender differences in access.
- Do you think that there are challenges of being a male or a female breadwinner in this locality today?

Section B: Perception of climate change and in-situ adaption strategies

3. Can you tell me about weather and environmental conditions in the locality?

- Are you witnessing any changes in drought? How does this affect your farming activity? Probe whether farm produce has increased or decreased. Probe if diseases have increased due to changes. How does this affect the different social groups?
- Are you witnessing any changes in flooding? How has this affected farm activities. How does this change affect the various social groups in your community?
- Are you witnessing changes in temperature? How does these changes in temperature affect males and females in your household? Are there any gendered differences in the effects of flooding in this community?

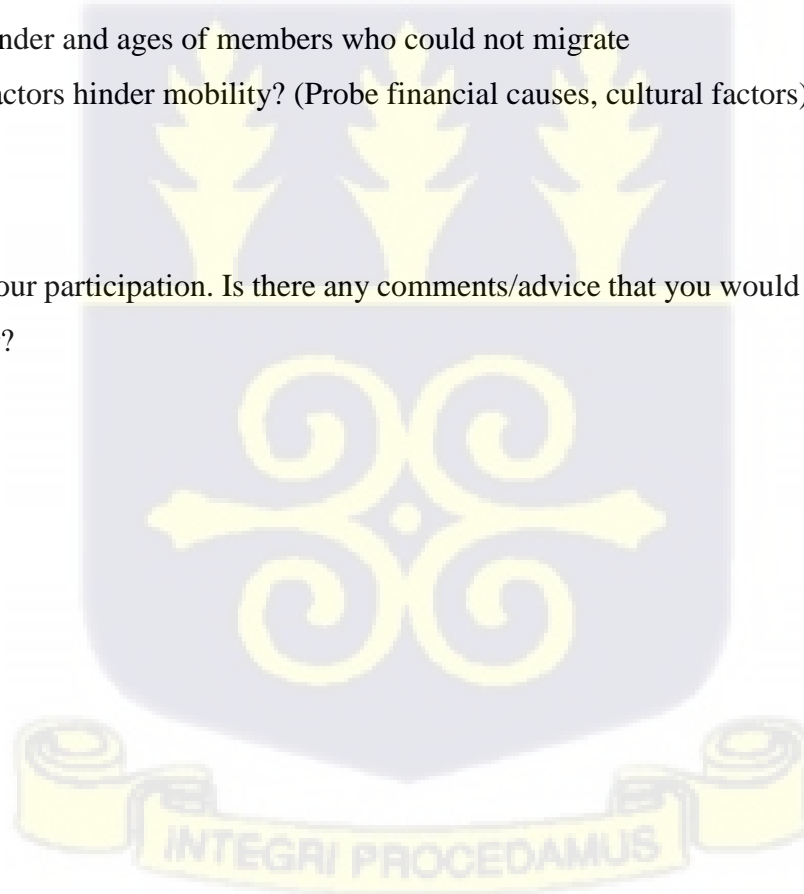
- Are you witnessing changes in rainfall pattern in this locality? What are these changes? Does rainfall variability affect men and women differently or the same?
 - How does the community as a whole respond to these changes? Probe how various social groups respond to these changes. Probe what influences the response to these changes
 - Probe whether community members adopt any of strategies such as intensification of irrigation; improved crop varieties; changes in planting time; off farming activities; crop insurance; seasonal migration; permanent migration on some household members)
 - Probe whether male, female and youth community members have equal opportunities for adopting these strategies?
4. Have there been any organized initiatives/ projects to address changes in rainfall, temperature and drought?
- Probe the nature of the intervention: who funded the intervention?
5. What has been/is the effects of the interventions/programmes implemented to deal with climate change? (Positive and negative effects)
- Probe whether the effects of interventions on men, women and the youth in the community are the same?

Section C: Climate- related (im)mobility

6. Are there members of the community that have migrated?
- Probe gender, ages, length of migration, destination)
 - Do you think that this community support female migration? Explain?

- What do you think influences members to migrate? Probe for specific climate-induced migration factors eg. drought, floods, and temperature changes and socio-economic factors (e.g no incentive for agriculture, education, marriage etc)
- Probe for which factors influence a specific social group more.
- Do migrants return to the community. Which social group is likely to return to the community?
- Probe if return migrants aid in community development.
- Probe which social group is more likely to return
- Probe the cause of such return
- Do you think more member are likely to migrate? Probe which social group will likely migrate.
- Are there some members who wanted to migrate but could not do so?
- Probe gender and ages of members who could not migrate
- Which factors hinder mobility? (Probe financial causes, cultural factors)

Thank you for your participation. Is there any comments/advice that you would would like to give to the researcher?



Appendix 3: In-depth Interview Guide

Section A: Household Characteristics and Livelihoods

1. Background information

- Village or Town:
- Sex:
- Age
- Current level of education:
- Marital status
- Household size:

2. Can you tell me about your household?

- Probe for number of males and females in household and relationship with each other and where they live.
- Probe level of education, age and sex of each household member?
- Probe the roles and responsibilities of members within the household? Who does what, including farm work, livestock rearing, other paid work and childcare, housework?
- Who takes decision on who does what and why?

3. Tell me about how you currently make a living.

- What livelihoods do male and female members of the family engage in?
- Do male and female members of this household have equal access to resources needed farming (e.g., land, labour, capital, fertilizer)? Probe reasons for any gender differences in access.
- In your perception, what are the challenges of being a male or a female breadwinner in this locality today

Section B: Perception of climate change and in-situ adaption strategies

4. Can you tell me about weather and environmental conditions in the locality?

- Are you witnessing any changes in drought? Is the severity increasing or decreasing? How does drought affect livelihoods of males and females in your household? Are there any gendered differences in the effects of drought in this community?
 - Are you witnessing any changes in flooding? Is the severity increasing or decreasing? How does flooding affect livelihoods of males and females in your household? Are there any gendered differences in the effects of flooding in this community?
 - Have you witnessed a rise in temperature? How does rising temperature affect males and females in your household? Are there any gendered differences in the effects of flooding in this community?
 - Have you witnessed changes in rainfall pattern in this locality? What are these changes? Does rainfall variability affect men and women differently or the same?
5. How do you and your household members respond to changes in climate (e.g., unreliable rainfall, increased temperature and drought)?

- Probe whether they adopt any of strategies such as intensification of irrigation; improved crop varieties; changes in planting time; off farming activities; crop insurance; seasonal migration; permanent migration on some household members)
 - Probe whether male, female and youth household members have equal opportunities for adopting these strategies?
6. Have there been any organized initiatives/ projects to address changes in rainfall, temperature and drought?
- Probe the nature of the intervention: who funded the intervention? Are these interventions exclusive to a particular gender?
7. What has been/is the effects of the interventions/programmes implemented to deal with climate change? (Positive and negative effects)
- Probe whether the effects of interventions on men, women and the youth are the same?

Section C: Climate- related (im)mobility

8. Are there any members of your household that have migrated from this community?
- Tell me about these persons who have migrated from this household and their migration history (probe gender, ages, length of migration, destination)
 - Do you see a difference between male and female migration from this community? (e.g, ages, motivations, destinations, seasonal, circular or permanent)
 - Does your household support female migration? Explain?
 - What triggered the decision of your household members to migrate from the community. Probe for specific climate-induced migration factors eg. drought, floods, and temperature changes and socio-economic factors (e.g no incentive for agriculture, education, marriage etc)
 - Did/does migrant keep in touch with the family? How (back-and-forth movements, visits, remittances)?
 - How has his/her migration affected wellbeing of your household members?
 - Do you receive remittances (money of goods) from your family or friends who have migrated? Probe who manages remittances on behalf of household? (Males or females)
 - Does the receipt of remittances help you in any way to deal with climate change?
9. Do you yourselves wish to / plan to move elsewhere? Why? To where?
10. Are there some household members who wanted to migrate but could not do so?
- Probe gender and ages of household members who could not migrate
 - Which factors hinder mobility? (Probe financial causes, cultural factors)

Name of Person (To be collected after interview):

Phone number:

Age:

Thank you for your participation. Is there any comments/advice that you would like to give to the researcher?

Appendix 4: Key Informant Interview Guide

Interviewee's Background information

- Sex:
- Village/Town:
- Current Level of education:
- Organization:
- Position

1a. Can you tell us about the history of this community/district/ region in relation to climate-induced migration within and out of the community?

- Probe economic activities, level of education, age and sex of community members who usually migrate?

1b. What is the major source of livelihoods of community members?
Probe the livelihoods of different social groups including gender and age groups,

1c. How has climate-induced migration affected the various forms of livelihoods in the community. Probe its effects on various social group: male and females, old and young

SECTION B: Perception of Climate Change and in-situ adaptation strategies

2. Tell me about weather conditions in the locality. Probe for recent changes in weather conditions such as increase in temperature, unreliable rainfall patterns.
3. What do you think are the causes of these changes? Probe what community members think are the causes of these changes. (Attribute it to the natural or government or any other related cause)
4. How do these change in weather conditions affect the livelihoods of community members? Probe the effects on women and men. The old and young. Farmers and non-farmers.
5. What strategies have community members adopted to tackle the effects of these changes on their livelihood. Probe the various strategies by men women old and young. Probe what strategies are popular within a particular social group

- Have there been any strategies put in place by organizations or individuals to tackle the effects changes in weather conditions have on community members livelihoods. Probe the impacts of these strategies on various social groups in the community.

SECTION B: Climate immobility

6. Are the members of your community who have migrated out of your communities?
 - Probe the cause of migration such as **Environmental/ecological change**- e.g Flooding; Drought; Bush fires;
 - **Political Change** -e.g Democratic governance ; Ethnic Wars; Conflicts
 - **Economic Change**-e.g. shortage of land, availability of capital, Income levels; Probe those who are more likely to migrate due to weather changes, political and economic changes
7. Are the differences between male and female migration? Probe for decisions, societal status, etc.)
8. Are there some groups directly affected by climate change but do not migrate? Probe reasons such as adoption of adaptation strategies, inadequate resources
9. Which groups are less likely to migrate Probe gender, causes such as societal norms, resources? Probe for specific climate-induced migration factors eg. drought, floods, and temperature changes and socio-economic factors (e.g no incentive for agriculture, education, marriage etc)
10. Which social group is more likely to keep in touch with family members/community after migration?
11. How has his/her migration affected the wellbeing of the community. Probe community projects, decline in farm produce, more help to deal with climate change

Name of Person (To be collected after interview):

Phone number:

Age:

Thank you for your participation. Is there any comments/advice that you would like to give to the researcher?