IMPLICATIONS OF LAND TENURE RIGHTS ON FARMERS' ADAPTIVE CAPACITY TO CLIMATE VARIABILITY AND CHANGE IN SEMI-ARID NORTH-WESTERN GHANA: THE CASE OF CROP FARMERS IN THE LAWRA DISTRICT

BY

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DECLARATION

I **Francis Awaafo Akugre**, hereby declare that this thesis "Implications of Land Tenure Rights on Farmers Adaptive Capacity to Climate Variability and Change in Semi-Arid North-Western Ghana; the Case of Crop Farmers in the Lawra District" is the result of my own work and supervised by Dr. Kwadwo Owusu and Dr. Wrigley-Asante Charlotte. I have duly acknowledged and referenced people whose work supported the outcome of this thesis. I also wish to affirm that this work has not been partly or wholly submitted to any other institution to be awarded another degree.

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ABSTRACT

The study examined the implications of land tenure rights on crop farmers' adaptive capacity to climate variability and change in semi-arid north western Ghana. A mixed research design; concurrent triangulation strategy involving household questionnaire survey, focus group discussions and key informant interviews was employed in collecting primary data from 192 sampled crop farmers from four communities in the Lawra District. Qualitative data were transcribed and manually analyzed whilst cross tabulations, chi square test and binary logistic regression techniques were employed in analyzing quantitative data using SPSS version 21 and Microsoft excel 2010.

The results confirmed that majority of the farmers especially, women were cultivating on smaller and insecure land parcels with largely user rights. Perceived level of farmland tenure security was reported as minimum among majority of the farmers but this was high among female farmers. The main socio-economic characteristics that significantly determined farmland tenure security among the crop farmers were; age, sex (gender), and type of land tenure rights. Farmers' adaptation decisions were partly influenced by land tenure rights and other socio-economic variables either than land tenure rights. However, land tenure rights had cascading effects on other socio-economic characteristic of the farmers which limited their adaptive capacity particularly the female crop farmers.

It is recommended that climate change adaptation policy makers, particularly in relation to the agricultural sector, should design community based adaptation policies and projects that will be targeted at improving access to land and tenure security among all social groups of farmers. Apart from that, educating the farmers on agricultural intensification will be the best option since majority of them had only smaller acres of farmland. This should be carried out by MOFA through its agricultural extension officials.

DEDICATION

This thesis is dedicated to my mother, Mma Apika Nmiyele Akugre for her moral support and prayers towards a successful completion of this work.

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LIST OF ACRONYMS

NGOs	Non-Governmental Organizations
MOFA	Ministry of Food and Agriculture
LAC	Local Adaptive Capacity
GSS	Ghana Statistical Service
PNDCL	Provisional National Defense Council Law
LAP	Land Administration Project
MLNR	Ministry of Lands and Natural Resources
FAO	Food and Agricultural Organization
GPRS	Ghana Poverty Reduction Strategy
FGDs	Focus Group Discussions
SPSS	Statistical Package for Social Sciences
EPA	Environmental Protection Agency

CHAPTER ONE

INTRODUCTION

1.1 Background

The importance of land for climate change adaptation among smallholder farmers cannot be underestimated (Antwi-Agyei, Fraser, Dougill, Stringer, & Simelton, 2012; Maru, Smith, Sparrow, Pinho, & Dube, 2014). Land is a basic asset that influences farmers' choice of adaptation strategies (Garnett et al., 2013). Apart from this, land is a basic resource for ensuring food security, poverty reduction and overall development which when not addressed could exacerbate vulnerability to climate change (Antwi-Agyei, Dougill, & Stringer, 2015). According to Pelling, O'Brien, and Matyas (2015), farmers' adaptive capacity to climate change is largely based on access to resources among which land forms a critical component. However, access to land and equity in the distribution of land resources for the enhancement of sustainable adaptation still remains a problem (Lestrelin, Bourgoin, Bouahom, & Castella, 2011). This could be a challenge for some farmers in many parts of the world especially in Africa where resources are largely distributed in favour of power holders and the rich at the neglect of the many marginalized individuals (Browning, 2010).

Farmers' access to and security over land is determined by land tenure rights which are largely influenced by economic, political, institutional policies and local traditional norms (Doss, Summerfield, & Tsikata, 2014). In many parts of Africa, land tenure varies from various settings and is compounded by a set of values that are built on culture (Donkor & Owusu, 2014). This may lead to conflicts among interest groups especially in areas where land is a scarce resource, thereby exacerbating vulnerability to climate change. According to Udry (2011), customary land tenure remains the common means of land ownership in

Africa and varies according to ethnicity. However, state or statutory land rights exist but do not protect farmers land rights (Rahmato, 2010). In Ghana, customary land tenure remains the major means of land ownership consisting of stool, skin, clan, family and individual lands (Kojo S Amanor & Ubink, 2016). Whilst customary land rights are patrilineal in some parts of Ghana particularly the three northern and parts of the Volta regions, it is matrilineal among other ethnic groups like the Akans. However, conflicts over ownership of land continue to dominate in most parts of Ghana, thereby depriving some farmers' access to land for farming (Kojo Sebastian Amanor, 2010).

Some researchers have argued that customary practices mostly discriminate against women with regards land tenure arrangements (Tsikata & Yaro, 2014). Men are reported to be at the advantage and influence decisions on land with chiefs, "tindaanas" (earth priests) and clan heads. Ahmed, Lawson, Mensah, Gordon, and Padgham (2016), observed that there is increased inequality among women in decision making and access to land in semi-arid north-western Ghana due to customary norms which favour men more than women. Damnyag, Saastamoinen, Appiah, and Pappinen (2012), also found that, based on different tenure arrangements in Ghana's high forest zone, majority of farmers acquired their farmlands through customary freehold, share cropping and lease hold respectively which limited most farmers to the adoption of only short term adaptation practices. Tenant farmers mostly adopt short term farm management practices, such as mulching and manure application whilst secure land owners include long term adaptation measures like agroforestry (Antwi-Agyei et al., 2015).

1.2 Problem Statement

Climate variability and change remains a serious threat to many crop farmers particularly in most parts of Africa, of which Ghana is not an exception (Schlenker & Lobell, 2010). In Ghana, this is more pervasive in the northern part where the rainfall regime is uni-modal

(Nyantakyi-Frimpong & Bezner-Kerr, 2015). In promoting the adaptive capacity of farmers, numerous efforts have been made towards improving resources governance especially at the local levels in order to improve access and equity in the distribution of resources that are needed for effective adaptation (Eriksen et al., 2011; Laube, Schraven, & Awo, 2012). In the same vein, a lot of scientific and social research have also focused on promoting farmers adaptation to climate change (Boansi, Tambo, & Müller, 2017; Brown, 2011). Governmental agencies such as MOFA and EPA as well as Non-governmental Organizations (NGOs) have also been playing various roles to support farmers in their adaptation process (CARE, 2012; Sarpong & Anyidoho, 2012; UNDP, 2013). These efforts are all aimed at enhancing farmers' adaptive capacity.

However, most farmers still face challenges in adapting to the impacts posed by climate variability and change (Yaro, Teye, & Bawakyillenuo, 2015). Various schools of thought seem to largely attribute this phenomenon to lack of access and inequality in the distribution of basic resources like land which constitute a core productive asset in farmers adaptation and in the overall agricultural production process (Aha & Ayitey, 2017; Bawakyillenuo, Yaro, & Teye, 2016; Tsikata & Yaro, 2014). The predominance of customary land tenure rights has created more inequity in terms of promoting secure to land rights among many farmers (Ahmed et al., 2016). Farmers land rights are influenced by customary norms which limits women's access to land (Awumbila & Tsikata, 2010; Udry, 2011). Not only is customary land tenure rights a gender issue but it also disadvantages migrants and landless youth farmers and some native male farmers within their extended family level (Kidido, Bugri, & Kasanga, 2017). Increased incidence of land conflicts and the fight over landed resources such as pasture, water, and low lands have been on the increase due to inequality of access created by biased land tenure rights (Obeng-Odoom, 2012).

Indeed, though a lot of studies have looked at land tenure rights and its gender dimensions, see (Alfred & Bonye, 2012; Awumbila & Tsikata, 2010; Udry, 2011), there seem to be limited studies that have directly looked into the effects of tenure rights on farmers' ability to sustainably adapt to the impacts of climate variability and change, see (Antwi-Agyei et al., 2015). Given this phenomenon, various scholars such as Abebe (2014) have recommended for further research in order to adequately explore the effects of property rights particularly land tenure rights on smallholder farmers' adaptation to the impacts of climate variability and change. Therefore, underpinned by the progressive social theory of Himmelman (1996) and the Local Adaptive Capacity (LAC) theoretical framework of , Jones, Ludi, and Levine (2010), this study sought to examine the implications of land tenure rights on crop farmers' adaptive capacity to climate variability and change in the Lawra District. It is hoped that the findings of this study will contribute to more knowledge and inform the decisions of climate change adaptation policy makers towards sustainable adaptation among farmers.

1.3 Research Questions

Generally, what are the implications of land tenure rights on crop farmers' adaptive capacity to climate variability and change in semi-arid north western Ghana?

Specifically, the study sought to answer the following questions;

1. What are the forms of land tenure arrangements among crop farmers in the Lawra District?
2. What is the perceived level of farmland tenure security among crop farmers in the Lawra District?
3. What factors determine farmland tenure security among crop farmers in the Lawra District?

4. What is the influence of land tenure rights on crop farmers' choice of on-farm adaptation strategies in the Lawra District?

1.4 Research Objectives

The main objective of the study was to examine the implications of land tenure rights on crop farmers' adaptive capacity to climate variability and change in semi-arid north western Ghana.

Specifically, the study sought to;

1. Identify the forms of land tenure arrangements among crop farmers in the Lawra District.
2. Ascertain the perceived level of farmland tenure security among crop farmers in the Lawra District.
3. Identify factors that determine farmland tenure security among crop farmers in the Lawra District.
4. Determine the influence of land tenure rights on crop farmers' choice of on-farm adaptation strategies in the Lawra District.

1.5 Significance of the Study

Effective climate change adaptation requires a lot of policy reforms that could build the adaptive capacity of many vulnerable groups especially farmers. Land tenure remains an essential issue in climate change adaptation especially among farmers since the adoption of adaptation strategies cannot be done in isolation of land. However, the existing state of land ownership in Ghana, largely customary, remains researchable in order to ascertain its influence on farmers adaptation and hence food security.

The study's results are expected to inform climate change adaptation policy makers and organizations on the role of land tenure rights in enhancing farmers' adaptive capacity and the need to address the inequality that may be associated with access to and tenure security over land.

The results of the study will also add to the existing body of knowledge on land tenure rights pertaining to climate change adaptation, especially in northern Ghana.

1.6 Scope of the Study

The study examined the implications of land tenure rights on crop farmers' adaptive capacity to climate variability and change in the Lawra District and specifically looked at the forms of land tenure arrangements, perceived level of farmland tenure security among crop farmers and identified factors that determine farmland tenure security among the farmers. It further examined the influence of land tenure rights on farmers' choice of on-farm adaptation strategies.

The Lawra District was chosen for this study because, it is located in the Upper West Region which is classified as the poorest region of Ghana with poverty prevalent rate of about 70.7% (GSS, 2014). Therefore, it was necessary to examine how land tenure rights serves as barrier in farmers' efforts to sustainably adapt to climate variability and change since over 80.3% of the people in the district depend solely on agriculture as their means of livelihood. Apart from that, the Lawra District lies within the semi-arid zone of Ghana and therefore more vulnerable to the impacts of climate variability and change (Ahmed et al., 2016), hence the need to examine the implications of land tenure rights on farmers adaptive capacity.

1.7 Operational Definition of Concepts

Land Tenure: John Bruce (2012), defined land tenure as a social structure that encompasses complex rules governing land ownership and use.

Land Rights: Land rights are defined as the claims that are legally and socially recognized and enforceable by an external legitimate authority which could be a village level institution or an institution at a higher state level. Land ownership is synonymous with land rights and is defined generally by the land tenure system that basically determines an individual's ability to gain access to land and to have security over such land (Kapitingana, 2014).

Adaptive Capacity: Adaptive capacity is defined as the ability of a system to adjust to climate change (including variability and extreme events) to moderate potential damages and to take advantage of opportunities or to cope with the consequences (Schlenker & Lobell, 2010).

Climate Variability: Climate variability refers to the variations in the mean state and other statistics (standard deviation and extreme occurrences etc.) of the climate on all temporal and spatial scales beyond that of individual weather events (Solomon, 2007).

Climate Change: According to Stocker (2014), climate change "refers to a change in the state of the climate that can be identified (eg using statistical tests) by changes in the mean and/ or the variability of its properties, and that persist for an extended period typically decades or longer which could be due to natural variability or human activity".

1.8 Thesis Outline

The thesis is organized into six chapters. Chapter one consists of the background to the study, research problem, research objectives and hypotheses, the significance of the study and finally the scope of the study. Chapter two consists mainly of reviewed literature

relevant to the objectives of the study. It also includes the conceptual framework of the study. Chapter three also consists of a description of the study area and the research methodology whilst chapter four presents the study results. Chapter five contains a discussion of the results and findings of the study whilst chapter six covers a summary of the main findings of the study, conclusion, and recommendations.

CHAPTER TWO

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.0 Introduction

This section reviews literature on the concept of land tenure, customary land tenure, land policies in Ghana, adaptive capacity, forms of land tenure arrangements, perceptions of farmland tenure security, determinants of farmland tenure security and influence of land tenure rights on the choice of on-farm adaptation strategies among farmers. This section also describes the conceptual framework for the study.

2.1 Concept of Land Tenure

The concept of land tenure is viewed differently by various schools of thought. Access and use of land in any setting are enshrined in an institutional framework that dictates who gets that land, when and how. J Bruce, Wendland, and Naughton-Treves (2010), describes land tenure as denoting who can use what land and how that land should be used. Land tenure is also described as relationships that exist among individuals in a community regarding their rights to land (Mooya & Cloete, 2008).

John Bruce (2012), emphasized that land tenure ought to be considered largely as a social structure that encompasses complex rules governing land ownership and use. However, these rules vary across different societies and communities. German, Schoneveld, and Mwangi (2013), opined that, land tenure outlines how land ownership are acquired. It is a framework of procedures through which access to land, its management and control fit within a broader set of social, political and economic principles which are subject to societal change and reconstruction. Daley and Pallas (2014), assert that land tenure is derived from “Natural Resource tenure” describing how natural resources are controlled.

2.1.1 Land Tenure in the Context of Ghana.

The Ghana national land policy (1999) puts land ownership into two main categories; state or public land ownership and private land ownership. It describes state lands as lands compulsory possessed by the government supported by the powers vested in the president and held in trust by the state on behalf of the people of Ghana. On the other hand, private lands are mostly under the communal ownership and held in trust by a stool or skin of family on behalf of the community, groups or individuals. In between private and state land ownership is vested lands which are a form of split ownership between the state and traditional owners.

Customary land tenure remains the dominant form of land ownership in Ghana (Tsikata & Yaro, 2014). The major feature of customary land tenure is that land is regarded as an asset for whole society but not only individuals (Kojo S Amanor & Ubink, 2016). For instance (Kombe & Kreibich, 2000) posited that under customary land tenure, land ownership is attained at clan, family or lineage levels whilst individuals only enjoy unrestricted rights of usage. More so, Gough and Yankson (2000) assert that customary land tenure is formally recognized as an institution and forms a basic component of every traditional society.

Benneh, Kasanga, and Amoyaw (1996), indicated that when society was governeded strictly by customary law, land was embodied in the right of ancient groups defined as stool or skin, family, and similar affinity groups. The concept of customary land tenure remains dominant in most parts of Ghana covering up to 80% of land ownership despite social, economic and political changes that have taken place over the years (Berry, 2009). Under customary land tenure, rights are vested in chiefs or elders, land priests and family heads. This varies according to lineage and location. For instance in the Northern Region of Ghana, customary land rights are vested in skins whereas, in the Upper East and Upper West regions, it is held by the tendana (land priest). Among the Akan ethnic group in southern parts of Ghana,

customary land rights are vested in the stools represented by the chief. This applies mostly to vacant lands but in many instances, land rights remain under the control of matrilineal lineages (Arko-Adjei, 2011).

2.1.2 Land Tenure Policies in Ghana

Since after colonialism, administration of customary and statutory land has gone through several reforms. In the early post-independence regime, the state land administration witnessed the evolution of state institutions notably the lands commission department (Kasanga & Kotey, 2001). This was to satisfy a national interest in land deals, correct anomalies and problems that were common in the customary land sector, introduce written records through land deeds and titles registration, promote tenure security and to promote investment in landed property and finally, to facilitate development by making land acquisition procedures easier. However, the focus of the reforms in the land sector was not necessarily to protect indigenous poor farmers but to guarantee tenure security for the state. In this regard, many land laws were enacted including state institutions like the Lands Commission Department through Act 362 following the 1969 constitution.

Subsequently, a national land policy was formulated in 1999. This policy was amended in 2002. The policy was aimed at facilitating the growth of the economy (Anaafo, 2015). Its focus was also to bring poverty to a minimal level and ensure that there was social stability by improving the secure access to land, simplify the process for land acquisition and promoting fairness, transparency and efficiency in land deals (Whitehead & Tsikata, 2003). The objectives of the amendment of the national land policy were to;

(a) Harmonize statutory and customary laws to facilitate equitable access to enhance tenure security.

(b) Create and maintain effective institutional capacity at the national, regional, district and community levels for land service delivery.

(c) Promote community and participatory land management and land use planning within a decentralized planning system.

(d) Minimize and eliminate where possible the sources of protracted land boundary disputes conflicts and litigation in order to bring their associated economic costs and socio-political upheavals under control.

(e) Formalize land markets where appropriate and instill order and discipline to curb the incidence land encroachment, unapproved development schemes, indiscipline or illegal land sales, undue land speculation and land racketeering.

However, Land remains a contested resource among many user groups (Quansah, 2012). Access to land is increasingly influenced by political interferences and characterized by conflict, land grabbing and the increasing menace of land guards in most parts of Ghana. Land ownership remains largely in the hands of customary authorities (Awumbila & Tsikata, 2010). The national land policy also addresses challenges in the land sector which include; weak land administration, conflicts over land and expropriation of large tracks of land by the state without adequate consultation with land owners. It has rather increased the phenomenon of tenure insecurity and difficulty in accessing land for agricultural and other developmental purposes. Apart from that it has created more opportunities for the rich and power holders in the Ghanaian society to unduly own land at the expense of the poor and vulnerable thereby widening the gap of inequality especial among women in the semi-arid north of Ghana where the policy has failed to facilitate women's access and control over land for their farming activities (MLNR, 1999).

2.1.2.1 The Lands Administration Project of Ghana (LAP)

The Lands Administration Programme of Ghana is an initiative of the Ministry of Lands and Natural Resources which seek to implement the policy actions recommended in the National Land Policy document of 1999. The LAP is aimed at addressing the key issues that were identified by the national land policy document which includes; inadequate policy and regulatory framework, weak land administration regime with regards to both public and customary lands, indeterminate boundaries of customary lands, multiplicity of land disputes, and general indiscipline in land use, development and disposition. The LAP is being implemented in a 15-25 year period and divided into two phases. The first phase was launch in 2003 as government's commitment to reduce poverty and promote economic and social growth by improving the security of tenure, simplifying the processes of acquiring land by the populace, developing the land market and fostering prudent land management. The second phase is aimed at consolidating and strengthening land administration and management systems for efficient and transparent services delivery (MLNR, 2011).

2.2 The Concept of Adaptive Capacity

Mabe, Sienso, and Donkoh (2014), defined the adaptive capacity of a system as, the ability of that system to adopt or take up adaptation strategies to moderate the adverse impacts of climate variability and change. In relation to climate change, Schlenker and Lobell (2010) defines adaptive capacity as the ability of a system to adjust to climate change (including variability and extreme events) to moderate potential damages and to take advantage of opportunities or to cope with the consequences. In many parts of Africa, adaptive capacity is considered as low due to economic, demographic, health, education, technology, infrastructure, governance, and natural challenges (von Uexkull, 2014). Widespread poverty, inequitable land distribution and high dependence on natural resources are some of the elements that negatively influence adaptive capacity of any human system (Otufale,

2015). Similarly, (Miller et al., 2010) identified education, access to resources and infrastructure, wealth and better weather forecasting as vital for building adaptive capacity of any human system.

Moreover, drawing from (Pettengell, 2010), key components of adaptive capacity are that individuals should be adequately involved in the change processes through a change in attitude, resources distribution and technology development in order to better adapt to those processes of change. Revi et al. (2014), recognizes economic wealth, technology, information and skills, infrastructure, institutions and equity as principal indicators of adaptive capacity. However, the nature of governance structures and the roles and functions of institutions are issues that need to be better addressed.

Some school of thought, Elasha, Elhassan, Ahmed, and Zakieldin (2005), have used the five components of the sustainable livelihood framework notably capital; economic, social, human, physical and natural resources as indicators of adaptive capacity at the household level. However, Jones et al. (2010) criticized the use of the sustainable livelihood framework as a measure of adaptive capacity but, identified five distinct but interrelated features useful in determining adaptive capacity; asset base, institutions and entitlements, knowledge and information, innovation and flexible forward decision making. In communities where there are well defined social institutions, the propensity to better adapt to climatic shock is higher compared to ill-defined social institutions in that access to basic resources which are important components of the adaptation process is mediated by these social institutions (Maru et al., 2014). For instance, land tenure rules dictate how farmers acquire farmlands and the types of claims or rights they may have on those farmlands. These social institutions also influence adaptive capacity of some social groups like women farmers by dictating how resources like land should be distributed and who should be

entitled to such resources and this ultimately influence how individual farmers will choose to cope and adapt to the vagaries of climate variability and change (Jones et al., 2010).

However, access to resources alone is not a better indicator of adaptive capacity. Some school of thought argued that access to resources should be corroborated by access to appropriate knowledge and information about potential climatic threats, and understanding how to adapt to those threats is very crucial (Malik, Qin, & Smith, 2010).

Smit and Wandel (2006), also reiterated the significance of innovation in enhancing the adaptive capacity of any human system. A key aspect of adaptive capacity is the ability of a system to adopt innovation through new practices that are more effective and efficient in coping and adapting to climatic stress or shocks (Abay, Gandarillas, Shrestha, Waters-Bayer, & Wongtschowski, 2009). Ahmed et al. (2016), argue that though innovation is influential in a system's ability to adapt to climate variability and change, it must be supported by the requisite resources that will make it achievable. She cited that farmers' adaptive capacity may be undermined if they lack access and security over their farmlands. Similarly, Antwi-Agyei et al. (2012) discovered that adaptive capacity of many farmers in the three northern regions of Ghana was very low compared to the rest of the regions of the country. As part of their findings, poverty, and lack of access to basic productive resources like land among others largely accounted for the low adaptive capacity among many farmers.

Indeed, it is ascertained that socio-economic and environmental capital if properly developed equitably distributed, are pre-requisite for enhancing the adaptive capacity of farmers and other human systems, particularly in rural localities. Further, there is a strong believe that land is the most significant asset for sustainable adaptation and therefore the rights farmers hold to their farmlands influence their kind of adaptation strategies or

practices that they choose to adopt (N. C. Johnson, Wilson, Bowker, Wilson, & Miller, 2010). In the rural savanna areas of Ghana, Yaro et al. (2015) found that adaptive capacity of farmers was generally low which they attributed to poor state policies and high level of poverty. They identified that lack of access to assets like land and inequality in resource allocation largely affected the adaptive capacity of many farmers.

Table 2.1 Local Adaptive Capacity Framework (LACF)

Characteristic	Features that influence a high/low adaptive capacity
Asset base	Presence or absence of key assets that allow the system to respond to evolving or changing circumstances – natural, social.
Institutions and entitlements	The existence of an appropriate and dynamic institutional atmosphere that allows fair access and entitlements to key assets and resources.
Knowledge and information	The ability of a system to collect, analyze and disseminate information targeted at facilitating adaptive activities.
Innovation	The ability of a system to create an enabling environment that encourages and nurture innovation and experimentation in order to take advantage of new opportunities.
Flexible forward-looking decision making and governance	System's ability to accurately anticipate, incorporate and respond to changes through effective governance and planning.

Source: Jones et al. (2010)

Jones et al. (2010), developed a Local Adaptive Capacity framework (LAC) as shown in Table 2.1 which makes it easier to better understand and support adaptive capacity at the local level. The LAC framework, though similar to the Sustainable Livelihood Framework, identifies five different interrelated features namely; asset base, institutions and

entitlements, knowledge and information, innovation, and forward-looking decision-making which shape adaptive capacity at the local level.

2.3. Forms of Land Tenure Rights

The right to land includes the right to access, own, use, control, transfer, exclude, inherit and otherwise make a decision about land and its related resources (Borras Jr, Hall, Scoones, White, & Wolford, 2011). Individuals who are well educated, as well as local political power holders, have more secure tenure rights than those with no education and political power in their communities (Goldstein & Udry, 2008).

Land rights crucially influence land use planning and represent a complex set of socially and legally recognized claims enforceable by a legitimized authority either at a community level or a national level state institution (German et al., 2013). It is further admonished that land rights are dependent on the mode of land acquisition; inheritance, state transfer, tenancy arrangements or outright purchase characterized by various levels of authority on the use and management of land.

Whereas land may be acquired in numerous ways, rights to land are basically in three forms; user rights, control rights and transfer rights (Galiani & Schargrodsky, 2010). In the case of user rights, the holder of the land is given limitation with regards to the use of the land. Individuals are instructed to use the land for specific activities like crop production or grazing and even the types of crops are dictated in the agreement. Under control rights, land holders have the authority to take decisions regarding how and what to use the land for and to benefit fully from the use of the land. With transfer rights, there is more authority by the user. Here there is the right to transmit the land to heirs through inheritance, sell the land or to reallocate user and control rights (Wehrmann & Antonio, 2011).

Kapitingana (2014) identified similar forms of land rights; user, control and transfer rights and opined that rights to land are allocated and validated by title issuance or other forms of ownership registration. However, land rights are often associated with inequality regarding access to and use of land. For instance, user rights are often applied to women groups and the poor in communities. Also, the FAO (2010) identified other forms of land rights namely; communal land rights, open access, private and state rights. The FAO describes communal rights to land as rights that are common in the rural setting. With communal land rights, there exists a common right in a given community where each member may have the right to use the holdings of the community. Members of the community may have the right to graze cattle on a pastureland or water body without denial. Private land rights connote the assignment of land rights to a private party be it an individual, a group of people, married couple or a corporate body like a commercial entity. On the other hand, Seufert (2013) asserts that open access to land do not have specific rights assigned to individuals and as such, there is no one who can be excluded in the use of such lands. This may include rangelands, forests, etc. where there may be access to the resources for all. For state lands, rights are assigned to some authority in the public sector. For instance, forest lands may fall under the mandate of the state whether at the central or decentralized level of government.

Anseeuw et al. (2012), categorized land rights as residual rights, symbolic rights, freehold, and leasehold rights. Residual rights apply to when a land is under the pledge. The individual to whom the land is pledged continues to use the land perpetually until the land is redeemed. Also, symbolic right applies to where land has been donated for development project without any monetary attachment but mere recognition of the donor. With respect to freehold and leasehold rights, land rights could be classified as customary rights or statutory rights. Leasehold, freehold, and right of occupancy are examples of statutory rights and are clearly defined by stated laws or regulations.

2.3.1 Access to Land among Farmer Groups

Access to land simply connotes the means and ways through which individuals or groups acquire rights to use, control or transfer land. Access to land by rural farmers is usually based on customs. Land can be acquired through purchase, lease, sharecropping, inheritance, squatting illegally on land and compulsory acquisition by the government (Kojo Sebastian Amanor, 2010). Chu (2011), in examining gender differentials in access to assets found in parts of Sub-Saharan Africa that, male farmers were operating on larger land holdings whilst female farmers were operating on smaller land holdings. Gedzi (2012), opined that securing women land rights have been cumbersome in most parts of Africa in that women's access to land is largely hinged on lineage, inheritance, marriage, contractual agreement and in some instances through gift or purchase. Further, increasing level of peri-urbanism has also limited women rights to land for agricultural production (Tsikata, 2009).

Under the customary land tenure system in Ghana, access to land and control over it follows a rigid gender-segregated pattern hinged on traditional norms which place women at the disadvantage of acquiring land for farming. Awumbila and Tsikata (2010), adds that access and control over land by women is determined by male centred kinship institutions and authority which tend to restrict women's access to land in favour of male farmers. Women's land rights issues also became topical during the World Conference on Women in Beijing in 1995. Concerns were raised against the denial of women access to and security over productive resources like land. Under the platform, Ghana was charged to put in place programmes that will increase women especially subsistence farmers access to land and ensure that women are tenure secure (Platiner, 1995). Furthermore, a report of the Ghana Poverty Reduction Strategy I (GPRS I, 2002) showed that women faced challenges in accessing land for farming and that women who had small parcels of farmland were tenure

insecure. Traditional norms and institutional procedures were the major barriers to women land rights in most parts of Ghana (Kwapong, 2009).

It is also recognized that women in most parts of Ghana particularly in northern, Upper East and West regions lose their land rights when they lose their husbands (Bonye & Kpieta, 2012). Women generally cultivate on small plots of land with low soil quality making them more prone to drought, floods, privatization, and expropriations. The arrangements through which women acquire land put them in a disadvantaged position with regards to tenure security (B. A. Duncan, 2010). Musembi and Kameri-Mbote (2013), are of the assertion that due to the gendered division of labour, women spend much of their time working on land but yet have limited right of ownership, access, and control over land. She bemoaned that, the denial of women's rights to land is a denial of their social, economic and political autonomy necessary for full membership in any given society. Agarwal (2003), observed that women's rights to land and tenure security have been curtailed by discriminatory customary laws and government policies that have tend to support land commercialization as well as competition in land demand.

Again, Bonye and Kpieta (2012), also argued that efforts aimed at giving women a voice to articulate their position in land matters have not been satisfactory. In assessing women ownership and access to land in the Upper East Region of Ghana, they observed that women do not own land because they do not sacrifice to the land spirits. Again, J. S. Duncan (2004), observed in some parts of the Volta Region of Ghana, that whilst men had full access rights to land, women had conditional or partial rights. It was further ascertained that access to land was largely influenced by gender, land ownership system, local traditions and norms, decision making powers and marital status of the respondents. In patrilineal societies in Ghana, women do not own land because; they are not permanent members of their paternal homes and that they are under their husbands (Alfred & Bonye,

2012). In Ghana and other African countries, land represents a source of economic, political and social power which translates into control over other resources (Doss et al., 2014).

Land rental arrangements remain a common means of acquiring land by landless, poor youth, women and migrant farmers in most communities. A study of indigene and migrant farmers in the Western Region of Ghana by (Damnyag et al., 2012) showed that land rental arrangements were very common but varied in terms of exchange, duration and use rights

2.4 Perceived Farmland Tenure Security among Farmers

Tenure security remains critical in spurring agricultural investment and productivity. Perceived tenure security forms the basis upon which land holders can be expected to land related decisions. Perceived tenure security serves as a more direct proxy of tenure security than legal and actual tenure security (Sjaastad & Bromley, 2000). Perceived tenure security corresponds with the sense of security that is derived from a probability estimate of the chance of eviction or other factors that may threaten a tenure situation and may cause involuntary relocation (Ma, Heerink, Feng, & Shi, 2015).

Perceived tenure security of a rural land is a composite concept combining the farmers own assessment of their tenure situation (Rao, Spoor, Ma, & Shi, 2016). De Souza (2001), opined that perceived tenure security varies depending on who perceives it, how such tenure has been acquired, the actors involved in securing the land for a particular farmer or household and what is perceived as secure.

Reerink and van Gelder (2010), points out that actual tenure security for households settlement is generated by characteristics intrinsic to a settlement such as the length of time of use of land, size of the land and the level of cohesion of community organization and by factors extrinsic to a farmland such as third party support, the mobilization of media, political acceptance or administrative practices.

Legal tenure security is rooted in the property right paradigm. Land titles or registration have been considered as the main proxies of legal tenure security because they can reduce or eliminate uncertainty that land owners might have about land ownership (Van Gelder, 2010). According to Deininger, Ali, and Alemu (2011), tenure security is "the degree of confidence that land users will not be arbitrarily deprived of the rights they enjoy over land and the economic benefits that flow from it; the certainty that individuals rights to land will be recognized by others and protected in all cases of specific challenges; more specifically, the right of all individuals and groups to effective government protection against forced evictions".

Table 2.2 Indicators of Land Tenure Security

Relevant indicator	Details
1. Perception of future loss	The risk of losing a land.
2. Recognition of land rights held	Recognition by state, traditional land administrative authority and the local community.
3. Availability of titles	Ease of issuance, its essence, and role in security.
4. Loss of land in the past	Actual instance of loss of land rights
5. Threat of eviction	Protection from traditional authority
6. Bundle of rights held	Autonomy in right sale and exclusivity in enjoyment
7. Access to credit	Actual instances or perceived

Source: adapted from Hollingsworth (2014)

Hollingsworth (2014), identified; perception of future loss of farmland, the experience of previous loss of farmland, mode of land acquisition, duration of rights to land and conflicts over the land as proxy indicators of tenure security. See Table 2.2.

Van Gelder (2010), also suggests that tenure security should be viewed as a composite concept with three constituent elements: the perception of the land user with respect to his/her situation, the legal status of his/her tenure and the de facto conditions. He noted it is the interplay and relative relationships between perceived, de facto de jure tenure security that affects outcomes. He relates perception of tenure security to the individuals feeling about his own personal characteristics. Van Gelder's perspective is complementary to the findings of (Lanjouw & Levy, 2002).

Security of tenure is a multi-dimensional concept that cannot be measured directly. However, it is argued that the duration of holding land does not guarantee tenure security over such a land (Arnot, Luckert, & Boxall, 2011). Others have identified evictions, documentation to land, legal protection against forced eviction of farmers, the absence of land disputes, nature of land rights, the absence of discrimination in land rights and due process in the acquisition of land as indicators of tenure security (Payne & Durand-Lasserve, 2012). Ayamga, Yeboah, and Dzanku (2015), argued that farmers who continue to cultivate on their farmlands are less likely to lose their farmland under customary land tenure but feel insecure. However, farmers who felt secured about their land are those who will allow their farmland to fallow. Therefore, in measuring tenure security, the decision to allow a farmland to fallow was used as a proxy measure of land tenure security among farmers. Variables that were significant determinants of tenure security included; ancestry of farmers, age, land rights and land titles. Others have argued that land tenure security is measured by the formalization of individuals' titles to their farmland. Moreover Croppenstedt, Goldstein, and Rosas (2013), also observed that male farmers enjoy secure

land rights than poor landless, youth, migrant and female farmers. Similarly, Antwi-Agyei et al. (2015), found in the Bongo and Ejura Sekyedumase Municipality of Ghana that whilst female and migrant farmers perceived they were tenure insecure, male indigenous asserts their farmlands were highly secure. .

2.5 Determinants of Farmland Tenure Security among Farmers

Tenure security among farmers seems to be closely associated with their socio-economic and demographic characteristics. Antwi-Agyei et al. (2015), in examining the determinants of farmland tenure security in Ghana, found that tenure security among farmers were significantly influenced by land titling, being native to an area, types of crops cultivated, age of farmers, size of farmland, type of land rights and source of farmland among others. They observed that whereas aged farmers were less likely to lose their farmlands if allowed to fallow, young farmers were more likely to lose their lands if allowed to fallow. Ghebru and Holden (2015), asserts that tenure security is largely determined by the type of tenure system and the rights that a farmer holds to the given parcel of land. They emphasize that, farmers who acquired their lands through inheritance and purchase with transfer rights are more likely to feel tenure secure than farmers who operate on rented or sharecropping lands and lands obtained through a grant from family or community members. Also, found in Ethiopia that tenure security among farmers is largely influenced by gender, economic conditions such as income and the types of rights that farmers hold to their farmlands.

2.6 Land Tenure Rights and Climate Change Adaptation

In Mpolonjeni in Swaziland, Shongwe, Masuku, and Manyatsi (2014), found that the choice of adaptation practices was influenced by land tenure arrangement among other factors like age, access to credit, access to extension services and input prices. In determining factors that influence farmers' adoption of adaptation practices in South Africa and Ethiopia, found that, the size of farmland and lack of secure land rights significantly influenced farmers'

choice of certain adaptation strategies. The size of farmland and land rights including other factors like access to extension service significantly influenced farmers' choice of adaptation practices (Abid, Scheffran, Schneider, & Ashfaq, 2015). In assessing the impact of land tenure arrangement on the adaptive capacity of farmers in the Ejura Sekyedumase and the Bongo districts of Ghana, Antwi-Agyei et al. (2015) revealed that tenant farmers were using short term adaptation practices whereas farmers who had secured rights to their farmlands were using more efficient and long term adaptation practices. Farmers' choice of adaptation practices are determined by availability and access to capital resources; physical, financial, natural, human and social capital (Deressa, Hassan, Ringler, Alemu, & Yesuf, 2009).

In The Akwapim areas of Ghana, it was identified that powerful individuals who had more secure land rights invested more in choosing efficient adaptation strategies (Goldstein & Udry, 2008). People who rent land are of the view that customary land tenure prohibits them from cultivating crops or planting trees that last longer than annual food crops (Damnyag et al., 2012). Having more secured tenure to a plot increased the probability that individuals would plant trees, and undertakes a wide range of other investments such as drainage, irrigation, mulching, etc. that would enhance better yield (Owombo et al., 2014).

2.6.1 Farmers' Perception of Climate Change

In the province of Punjab in Pakistan, Abid et al. (2015) found that many farmers perceived a change in temperature and rainfall. Similarly, Akponikpè, Johnston, and Agbossou (2010) in assessing farmers' perception of climate change in parts of West Africa, found that majority of farmers perceived a change in the climate over the years. Farmers perceived late onset of rainfall, increase in the frequency of dry spells as well as increasing temperature. In the Limpopo Basin of Southern Africa, Bryan, Deressa, Gbetibouo, and Ringler (2009), discovered that a greater proportion of farmers perceived increased in temperature over the

years. However, rainfall was perceived by the farmers to be decreasing and characterized by inter-annual variability.

Bryan et al. (2009), found in southern Ethiopia that, majority of farmers (88.7%) perceived an increase in temperature whilst 90% perceived that rainfall amount; pattern and timing of onset had changed. Ochieng, Kirimi, and Mathenge (2016), also found in the Kitui county of Kenya that majority of the farmers perceived temperature is increasing. They found that atleast 90% of the farmers perceived a decrease in annual average rainfall over the last two decades.

In Ghana, Fosu-Mensah, Vlek, and MacCarthy (2012), found that majority of farmers (92%) in the Ejura Sekyedumase Municipality perceived a change in climate through increasing temperature. They also discovered that majority of the farmers perceived a decrease in rainfall volumes and frequency. Also, in the Vea catchment area of the Upper East Region, Limantol, Keith, Azabre, and Lennartz (2016), found majority of farmers perceived that temperature is increasing. However, farmers perceived there is a decreasing trend of rainfall over the years in terms of volume, and timing.

Dimmie (2016), noted that majority of farmers in the Sissala East District of Upper West Region perceived a change in the climate since the past thirty years through increasing temperatures and decreasing trend of rainfall. Moreover, Ndamani and Watanabe (2015) found in the Lawra District that, many farmers (82%) perceived there was increasing temperature whilst 87% observed a decreasing amount of rainfall which has made farmers to adjust their farming activities in order to withstand increasing conditions of dry spells and droughts.

2.6.2 On-farm Adaptation Strategies and Determinants of Adoption

Exploring the on-farm adaptation strategies of farmers as well as identifying the factors that influence the adoption of such strategies is very crucial for the assessment of farmers' adaptive capacity. On-farm adaptation strategies have been classified into two broad categories; crop management adaptation strategies and soil and water conservation management strategies (Akponikpè et al., 2010).

In Malaysia, Masud et al. (2017), found that farmers were practicing mixed cropping, use of improved irrigation systems, drought tolerant crop varieties and change of planting dates as strategies of adaptation. Influencing farmer's adoption of these practices was; age, farming experience, and farm size. Similarly, Hassan and Nhemachena (2008) in analyzing determinants of farm-level adaptation strategies in eleven African countries, ascertained that majority of farmers were practicing mixed cropping, intercropping and irrigation as ways of diversifying their crops for effective adaptation. They further found that the farmers' adaptation decisions were influenced by access to the market, agricultural extension service, formal credit, technology, and farm asserts.

Also, Mwongera et al. (2017), in their study found in some parts of East Africa that adoption of pest use, change of planting dates and use of short term crop varieties were common crop management adaptation practices among many of the farmers.

Apart from that, Ehiakpor, Danso-Abbeam, and Baah (2016), found in the Western Region of Ghana that farmer's adaptation decisions were influenced by their household size and sex among others. They identified crop diversification and application of chemical fertilizer as a common adaptation strategy among most farmers in the district. Armah, Al-Hassan, Kuwornu, and Osei-Owusu (2013), also found in the northern region of Ghana that the choice of adaptation strategies among farmers was positively influenced by the sex of household head, farming experience, ownership of a radio set, household size and access to

credit. Other variables such as age, education, farm size, awareness of climate change and farm cash income did not influence farmers' choice of adaptation practices.

Moreover, Antwi-Agyei, Stringer, and Dougill (2014) discovered in the Sudan savanna and Forest savanna transition zones of Ghana, that change of planting dates, use of short term crop varieties, crop diversification and planting of trees (agroforestry) were the common adaptation practices among farm households. In their study, they discovered that farmer's choice of adaptation practices were significantly determined by their level of education, household size and annual farm income among others. Most of the adaptation practices identified by several research works are similar to those strategies adopted in other parts of Africa. For instance, in the north east of Ghana, farmers rely largely on the use of irrigation, drought tolerant crop varieties and diversification of crops as measures of adaptation (Antwi-Agyei et al., 2012).

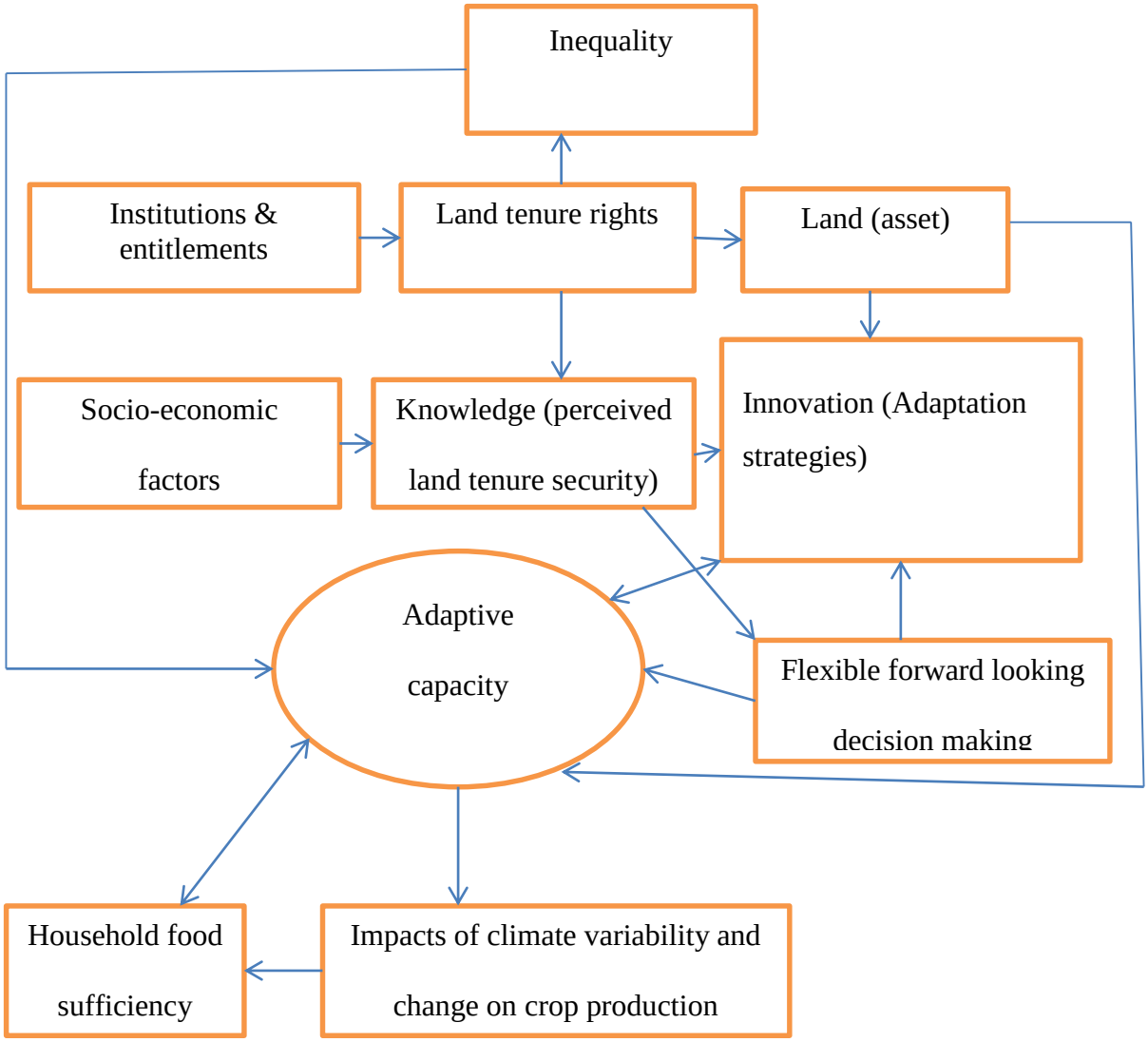
In a similar geographic setting, Bawakyillenuo et al. (2016) discovered in their study of determinants of adaptive capacity of farmers in the rural savanna of Ghana that, famers' choice of adaptation practices were significantly influenced by their sex, age, land ownership, education and perception of climate change. Also, in semi-arid Ghana, Ahmed et al. (2016) found that farmers were adapting to climate change by planting early maturing crop varieties, compost manure and agroforestry (tree planting).

Similarly, Ndamani and Watanabe (2016), found in the Lawra District of Upper West Region that crop diversification, change of planting dates and use of irrigation were the common adaptation practices adopted by farmers. They determined that educational level, household size annual income, access to information and being a member of farmer organization significantly influenced the choice of adaptation practices among the farmers.

2.7 Conceptual Framework

The conceptual framework of this study (see figure 2.1) is derived from Himmelman (1996) progressive social theory and the Local Adaptive Capacity (LAC) framework developed by Jones et al. (2010). The progressive social theory advocates for the recognition of individual ownership of resources irrespective of their socio-cultural groupings. The LAC framework though similar to the Sustainable Livelihood Framework also identifies five discrete yet interrelated features that shape local level adaptive capacity. These elements include asset base, institutions and entitlements, knowledge and information, innovation, and forward-looking decision-making. Land tenure rights are defined by institutions and entitlements as argued by Jones et al. (2010) which influences access to land as a resource (asset) for adaptation. Moreover, land tenure rights defined by institutions and entitlements influence equity in access to land among various farmers which have implications on farmers' adaptive capacity. Also, tenure rights among farmers influence their perception (knowledge) with regards to the tenure security of their farmlands which may influence their choice of innovations or adaptation strategies for adaptation. Again, when farmers get access to land as a productive resource or asset, it enables them to adopt innovations such as new farming technologies for adaptation. Farmers' ability to adopt innovation as part of adaptation is an indication of their adaptive capacity (Jones et al., 2010; Revi et al., 2014). However, farmers' perception of their land tenure security may be influenced by other exogenous (socio-economic) factors. In addition farmers' perceived level of their farmland tenure security influences their ability to accurately anticipate, incorporate and respond to changes through effective governance and planning (flexible forward looking and decision making). The choice of adaptation strategies by farmers depends on their adaptive capacity and consequently when farmers are able to adopt very effective and efficient strategies for adaptation; it may further improve their ability to adapt. See figure 2.1.

Figure 2.1 Conceptual Framework



Source: Author's own construct, 2017

This conceptual framework forms the thrust of the study and therefore, was applied as a basis for the design of the data collection instruments with regards to the questions that were answered by the research participants. It also guided the discussion of the research results as well as the drawing of conclusion and recommendations with respect to the study.

2.8 Summary

This chapter examined various debates on the concept of land tenure. It also examined land tenure policies in Ghana. Also, the concept of adaptive capacity to climate variability and change was also examined. Various forms of land tenure arrangements and tenure rights,

farmland tenure security, indicators of land tenure security, determinants of farmland tenure security with respect to farmers were also reviewed. Furthermore, the influence of land tenure rights on farmers' choice of on-farm adaptation strategies was examined. The final section of the chapter discussed the conceptual framework for the study and how it is applicable to the study. The next chapter presents a background of the study area and the research methodology that was employed in the study.

CHAPTER THREE

STUDY AREA AND RESEARCH METHODOLOGY

3.0 Introduction

This chapter gives an insight of the background of the study area, including its physical and socio-demographic characteristics. Additionally, this chapter discusses the research methodology which consists of the research design, data types and sources, sampling procedure and sample size, methods of data collection, data processing and analysis.

3.1 The Study Area

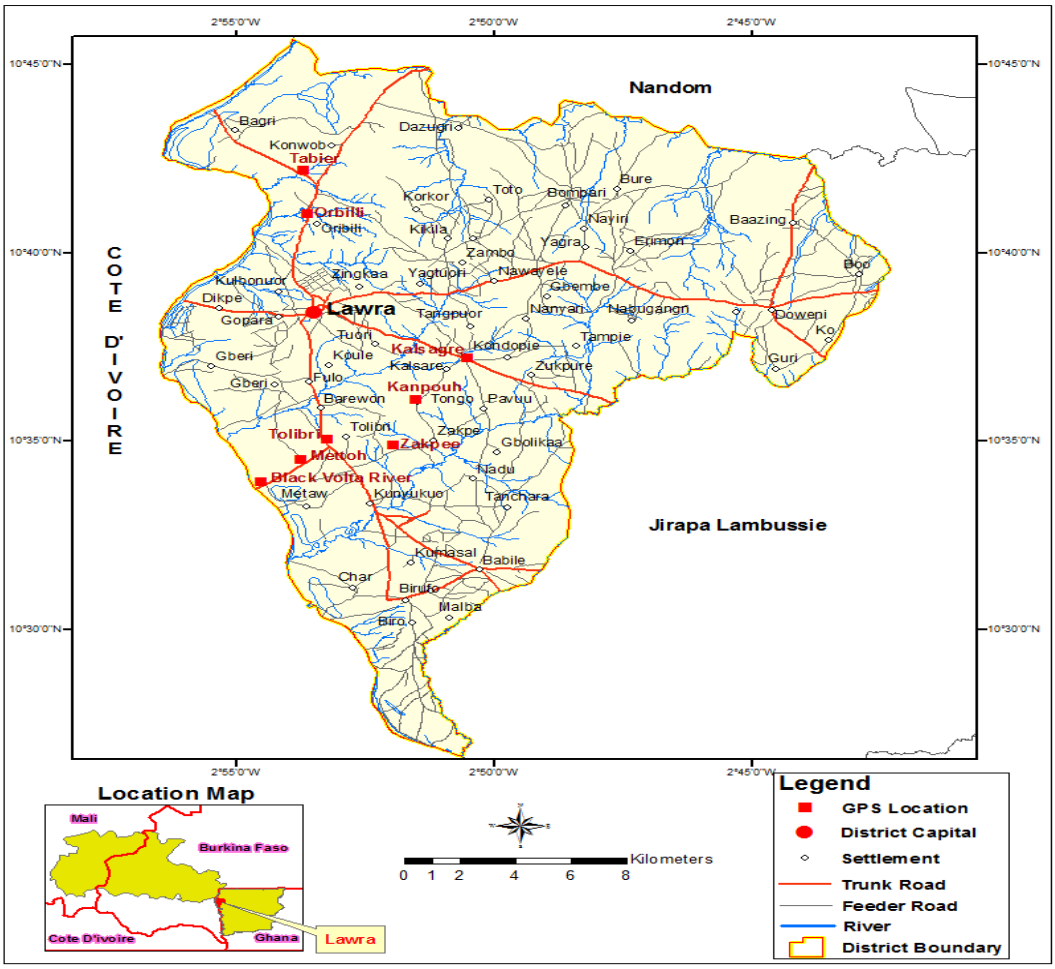


Figure 3.1 Map of Lawra District

This study was conducted in the Lawra District ($10^{o}35''$ and $10^{o}40''$ N; $2^{o}5''$ and $2^{o}53''$ W) located in the Upper West Region of North-Western Ghana. The district is boarded to the north by the Nandom District, to the east by Lambussie/Kani District (GSS, 2014) and to the south-west and west by La Cote d'Ivoire. The district covers a total land area of about 527.37 square kilometres representing 2.85% of the total land area of the Upper West Region (GSS, 2014). See Figure 3.1.

3.1.1 Relief and Drainage

The district is gently sloped with a few hills ranging between 180 and 300 metres above sea level. It is drained by the Black Volta River to the west forming a boundary between the district and La Cote d'Ivoire. It has several tributaries including Kamba/Danbang, Nawer, and Duodaa.

3.1.2 Vegetation and Climate

The Lawra District is found within the Guinea Savanna and has about 127 hectares of forest resources out of which 39.5 hectares have been converted into a protected area with an overall perimeter of 5.2kms (GSS, 2014). Common trees in the district are drought and fire resistant trees such as the baobab, dawadawa, shea trees and acacia. The greatest problem concerning the vegetation of the district is the prolonged dry season. During this period the grasses are normally dried and subsequent bush burning leaves the area patchy and mostly bare. This has resulted in the dwindling of the vegetative cover and poorer soil fertility. The degrading human activities span from cutting of tress for fuel wood and charcoal production, bush burning, and soil erosion to overgrazing by livestock.

The district lies within the Tropical Continental climatic zone with the mean annual temperature ranging between 27^{o}C and 37^{o}C. The period between February and April is usually the hottest. Between April and October, the Tropical Maritime Air Mass mostly

blows over the district which gives the only wet season in the year. The uni-modal rainfall pattern experienced in the district gives rise to only one cropping season in a year under the rain-fed agriculture which is widely practiced (GSS, 2014).

3.1.3 Geology and Soils

The rock formation in the district is basically Birimian with dotted outcrops of granite. There are indications of the presence of minor deposits of manganese, traces of gold, diamond, iron ore and clay (SRID, 2013). The soils in the district consist mostly of laterite soils. These are developed from the Birimian and granite rocks which underlie the area (GSS, 2014). There are also strips of alluvial soils along the flood plains of the Black Volta as well as sandy loamy along some of its tributaries. The soil types in the district are very degradable and of low fertility and poor moisture retention properties. Therefore, the nature of the soils coupled with the traditional land use practices tends to have some adverse effects on crop production in the district resulting in a persistent shortfall in agriculture production (GSS, 2014; MOFA, 2014).

3.1.4 Demographic Characteristics

This section describes the demographic features of the district including population size and distribution, age structure, migrant population, household size and structure, and literacy.

Based on the 2010 population census, the Lawra District has a total population 54,889 which constitute about 7.8% of the total population of the Upper West Region (GSS, 2014). Female constitute 52% of the population and males 48%. Out of the district's total population of 54889, 48397 (88.2%) are living in rural localities while the remaining 6,492 (11.8%) constitute an urban population. The spatial distribution of the population of the district indicates it more rural.

The age structure of the Lawra District follows the national pattern where a larger proportion of the population fall below 15 years and smaller proportion of elderly persons aged 65 years and older. In the district, children aged less than 15 years (0-14) represents 41.0%, persons aged between 15-39 years constitute 34.5%, and the elderly population (65+) constitutes only 7.4% of the district's population. The age group 40-64 years represents 13.5% of the district's total population.

Lawra District has a migrant population of about 3,777. The majority (63.2%) are from other regions of Ghana whilst 31.5% constitute migrants who are from different districts within the Upper West Region. About 53753 of the population live in a total of 9200 households. Out of these 9200 households, 74.5% are headed by males whilst 25.5% are headed by females. The average household size of the district is 6 persons per household. The rural areas have an average household size of 6.2 persons per household compared to 4.5 persons per household in urban areas. Based on the households headed males, 23.4% are nuclear and 47.4% are extended. With the households headed by females, 19% is nuclear and 47.5% are extended. The district is therefore dominated by an extended family system.

About 45.3% of the population aged 11 years and older are literate but 54.8% are not literates. The highest literate groups are the age group 15-19 years (28.4%), followed by 11-14 years (27.6%) and the lowest is the age group 65 years and more (1.9%). In terms of gender, illiteracy is comparatively higher amongst females (59.7%) than males (40.3%).

3.1.5 District Economic Background

A greater proportion of people in the Lawra District are farmers. The number of households engaged in agricultural activities is about 7680 and represents 83.5% of the 9200 households in the entire district (GSS, 2014). Of this number, 90.3% are in rural areas of the district with less than 10% in urban areas. Crop farming is the mainstay of agricultural

activities for over 56.5% of households in the district whilst livestock accounts for 43.3% (MOFA, 2013). The major types of crops cultivated in the district include; maize, millet, sorghum, groundnuts, soya bean, and cowpea. Animal production includes the rearing of goats, sheep, cattle and local poultry breeds (MOFA, 2014). However, agricultural production in the district is adversely affected by depleting soil fertility, poor rainfall pattern, limited investment capital and skills, pest and disease attack, poor access to extension services and low access to the market. These have largely resulted into low agricultural productivity in the district thereby making farming unattractive, especially among the youth (GSS, 2014).

3.2 Research Methodology

This section presents the research approach and methods that were employed in the study, including the research design, sampling procedure and sample size. It presents the techniques that were employed in the collection as well as the instruments that were used. The techniques that were employed in the data processing and analysis have also been discussed in this.

3.2.1 Research Design

A mixed research design; concurrent triangulation strategy was adopted for the study. According to Creswell (2013), a mixed research design is a research approach that combines both qualitative and quantitative research approaches in a study. Concurrent triangulation strategy is a mixed research design strategy in which both quantitative and qualitative date are concurrently collected by the researcher (w Creswell, 2009). Examining the implications of land tenure rights on farmers' adaptive capacity to climate change is a complex issue that needs the use of both qualitative and quantitative research approaches in order to provide a broader and more holistic understanding of the results (Teddlie & Tashakkori, 2010). The choice of this strategy was to offset weaknesses that would have

been associated with the use of only one approach. Teye (2012), also opined that, the use of mixed research design is useful for cross validation of field data. Though a few scholars including R. B. Johnson and Onwuegbuzie (2004), have affirmed that mixed research design comes with certain weaknesses and difficulties, it is argued that the use of mixed research design helps to ensure complementarity between quantitative and qualitative approaches, and therefore would enhance the quality and reliability of the research results. Further, complementing quantitative data with qualitative data (responses) would help provide more clarification on issues of land tenure rights and adaptation at the individual farmer level than relying on only one research approach.

3.2.2 Reconnaissance Study

As part of the study, a visit was paid to the Lawra District in the third week of August 2016. This was to familiarize with the study area and establish a close relationship with the community leaders and famer groups (research participants) and to get some preliminary information that would help in the proper framing of the research problem. Above all, the visit ensured that the research was placed within the situation of the research participants.

3.2.3 Sampling Procedure and Sample Size

A multi-stage sampling procedure was used for the selection of the study sites and respondents. The first stage was a purposive selection of crop farmers in the Lawra District since it is classified within the semi-arid zone of Ghana (Ahmed et al., 2016). Apart from that, evidence of climate change has also been reported in the Lawra District by various research works (Ndamani & Watanabe, 2015). It was also selected because it is largely agrarian and therefore likely to be vulnerable to the impacts of the climate of climate change (Naab & Koranteng, 2012). The second stage of the sampling process was a grouping of the district into four clusters; north, south, east and west. Four communities were then simple randomly selected from two clusters (eastern and southern clusters) which

were simple randomly selected from the four clusters. The essence of this was to avoid any biases in the selection of the study communities. The communities selected were; Kalsagre and Pavuu from the eastern cluster and Tolibri and Brewong from the southern cluster as shown in figure 3.1 above. The third stage was a stratified sampling of 48 crop farmers from 48 households in each community, making a total of 192 respondents. Stratified sampling is when a researcher divides his study population into subgroups say; males and females (Teddlie & Yu, 2007). The respondents were stratified based on three major socio-demographic characteristics; Gender (male/female), Ancestry (native/migrant) and age (aged/youth) farmers. This was aimed at ensuring that the various social groups of farmers were represented in the study since they may have had different issues with regards to land tenure rights and how it limits their adaptive capacity.

The sample size was determined using Slovin (1960), sample size determination formula. In all, a total sample size of 317 farm households was obtained from the calculation based on data on a total number of farm households in the various communities provided by an agricultural extension officer from the Lawra District. However, due to time and resources constraints, the researcher decided to survey 192 crop farmers from 60.6% of the 317 farm households obtained from the sample size determination. Thus, a farmer each was selected from 192 farm household which is a representation of 60.6% the total sample size (317 farm households) obtained from the sample size calculation (see Table 3.1). In addition, five key informants were selected for key informants' interview whilst four FGDs were conducted at the cluster levels (see Table 3.2 for details).

Sample size calculation;

$$n = \frac{N}{1 + N(e)^2},$$

Where n = sample size, N = total number of farm households and e = margin of error/precision (5%). See Table 3.1 below.

Table 3.1 Sample Size Determination

Community (Village)	Total farm households (N)	Sample size (n)
Pavuu	118	91
Tolibri	54	46
Kalsagre	152	110
Brewong	85	70
Total	409	317
		60.6% of 317 =192

Source: Field Data, 2017

3.2.4 Types and Sources of Data

Both primary and secondary data were collected during the study. Bhattacherjee (2012) explained primary data as data observed or collected based on first-hand experience. Primary data were collected from crop farmers comprising of their socio-economic and demographic characteristics and with regards to the objectives of the study. On the other hand, secondary data was obtained through a review of relevant literature from both published and unpublished materials including academic journals, books, reports, newspapers (both electronic and print) and archival materials from both the University of Ghana's library and the "Research Commons" internet facility. The essence of the secondary data was to help confirm the validity and reliability of results generated from the field (Flintermann, 2014).

3.2.5 Techniques and Tools of Data Collection

This section discusses the techniques and tools that were employed in the data collection process. The techniques included a household survey, key informant interviews and focus group discussions.

A household survey was conducted amongst crop farmers to collect data on their socio-economic and demographic characteristics, forms of land tenure arrangements, perceived level of farmland tenure security, determinants of farmland tenure security, perception of climate variability and change, on-farm adaptation strategies and influence of land tenure rights on choice of on-farm adaptation practices, using a survey questionnaire. The survey questionnaire which was semi-structured consisting of closed ended and open-ended questions was designed through a thorough review of literature based on the objectives of the study and was later pretested to ensure that it was clear and within the framework of the study.

Also, key informants interviews were conducted among traditional leaders (chiefs) in the selected communities and an agricultural extension officer. A total of 5 key informants were selected for the key informant interview. The aim of the key informant interview was to gain in-depth information on land tenure arrangements among the respondents and how land tenure rights influence adaptation among the farmers. The interviews were conducted partly in the local language (Dagaare) and English language. Permission was sought from the respondents after which audio recording of the interviews was done. In addition, qualitative data were collected through FGDs with crop farmers in the surveyed communities. (Wong, 2008) defines FGDs as a rapid assessment and semi-structured data collection procedure in which a researcher purposively select some participants to gather and discuss key issues drawn up by the researcher. The use of FGDs as a participatory approach was deemed necessary for the enhancement of the quality and reliability of data

obtained from the household survey. It helped in obtaining several perspectives from the participants based on the study objectives and corroborated the data obtained from the household survey. The FGDs were facilitated by a field assistant who was trained by the researcher to assist in the facilitation of the FGDs. The field assistant was needed due to the language barrier. A FGDs guide was used and audio recording was done after receiving the consent of the participants. The discussion was done in 'Dagaari' and later transcribed into English for analysis. A total of four FGDs were conducted; two FGDs were held separately for female farmers and male farmers at two zones. Each FGD was made up of 8 participants.

3.2.6 Data Processing and Analysis

The data were immediately cross-checked in the field and subsequently analyzed. The qualitative data were transcribed into English by a field assistant before it was manually categorized into themes, interpreted and presented in texts and direct quotation of the views expressed by the respondents according to the study objectives. The quantitative data were coded and analyzed using SPSS software version 21 and Microsoft excel version 2010 statistical package. Cross tabulations were done using the SPSS software version 21 in order to find the relationship between the demographic characteristics of the crop farmers and their farm level characteristics and determine the relationship between farmers' demographic characteristics and mode of land acquisition as well as types of land tenure rights. The cross tabulations were also done to determine the relationship between farmers demographic characteristics and their perceptions about their farmland tenure security. With the help of the Microsoft software excel version 2010 statistical package, the quantitative data were statistically summarized and tabulated for easy interpretation and understanding.

In addition, Pearson chi square tests were performed using the SPSS software version 21 in order to determine the relationship between gender, age and ancestry and other aspects of

land tenure arrangements as well as perceived level of farmland tenure security. Chi square test is a non-parametric test that examines the relationship between two categorical variables which are measured on nominal or ordinal scales (Flowerdew & Martin, 2005).

$$X^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i}$$

Where X^2 is Pearson chi square test, O_i is the observed frequency, E_i is the expected frequency.

But X^2 critical value at x degree of freedom = (r – 1) (c – 1). where r and c represent rows and columns respectively.

The decision rule is to accept H_0 if X^2 critical value is greater than the X^2 value or reject H_1 if X^2 critical value is less than the X^2 value.

Furthermore, in trying to determine factors that influence land tenure security among the surveyed crop farmers, a binary logistic regression model was used to examine the relationship between farmers' socio-economic characteristics and their perceived level of farmland tenure security. Similarly, a binary logistic regression model was used to examine the influence of land tenure rights on farmers' choice of on-farm adaptation strategies. Binary logistic regression is a statistical test that is performed to examine the relationship between one categorical dependent variable and independent variable (s) provided that the dependent or outcome variable has only two response categories (Peng, Lee, & Ingersoll, 2002). Binary logistic regression was chosen because of its consistency and therefore was more preferred in providing a meaningful explanation of determinants of land tenure security among farmers as well as farmers' choice of adaptation practices (Al-Ghamdi, 2002). It was also chosen because the outcome variables (decision to fallow a land which

served as a proxy measure of land tenure security and adoption of a strategy for adaptation) had two response categories. Each of the farmers either decides whether or not to fallow his/her farmland as well as whether or not to adopt a particular adaptation strategy. In addition, binary logistic regression was chosen because it was mathematically convenient and simpler (Hosmer Jr, Lemeshow, & Sturdivant, 2013).

3.2.6.1 Analytical Framework

Binary logistic regression model for measuring determinants of farmland tenure security; farmer's decision to leave a farmland to fallow for over 5 years without losing his/her rights to that land was used as a proxy measure of tenure security, see (Ayamga et al., 2015; Hollingsworth, 2014).

Table 3.2 Independent Variables Used in the Binary Logistic Regression Model

Independent variable	Mode of measurement	Expected sign
Age (x_{1})	Dummy: 1 = youth, 0 = Aged	+
Sex (x_2)	Dummy: 1 = male, 0 = female	+
Education (x_3)	Dummy: 1 = Lower than JHS/Middle school, 0 = JHS/Middle school or higher	-
Ancestry (x_4)	Dummy: 1 = indigene, 0 = settler	-
Land rights (x_5)	1 = user rights, 2 = control rights, 3 = transfer rights	+
Household size (x_6)	Number of persons	+
Size of farmland (x_7)	Dummy: 1 = up to 5 acres, 0 = above 5 acres	+
Farm distance (x_8)	Dummy: 1= less than 2km, 0 = 2km and more	+

Let the variable Y_i represent a farmer's decision to fallow a farmland, βx_i be a vector of explanatory (independent) variables and α_i be the error term associated with the estimated regression model.

$$Y_i = \beta + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 + \beta_{10} x_{10} + \beta_{11} x_{11} + \alpha_i$$

Where a farmer's decision to fallow a farmland is Y_i= 1 if he/she chooses to fallow his/her farmland and 0 if he/she chooses not to fallow his/her farmland. See Table 3.2 for coding of the independent variables.

Table 3.3 Independent Variables Used in the Binary Logistic Regression Model

Independent variable	Mode of measurement	Expected sign
Village (x_1)	1 = Pavuu, 2 = Tolibri, 3= Kalsagre, 4 = Brewong	-
Sex (x_2)	Dummy: 1 = male, 0 = female	+
Age (x_3)	Years	+
Ancestry (x_4)	Dummy: 1 = indigene, 0 = settler	+
Education (x_5)	Dummy: 1 = Lower than JHS/Middle school, 0 = JHS/Middle school or higher	-
Annual farm income (x_6)	1= Below GH¢600.00, 2 = GH¢600.00-GH¢1200.00, 3 = GH¢1201.00-GH¢1800.00, 4 = Above GH¢1800.00.	+
Land rights (x_7)	1 = user rights, 2 = control rights, 3 = transfer rights,	+
Access to agricultural extension service (x_8)	Dummy: 1 = yes, 0 = no	+
Perception of rainfall (x_9)	Dummy: 1 = increasing 0 = decreasing	+
Perception of temperature (x_{10})	Dummy: 1 = increasing 0 = decreasing	+

Binary logistic regression model to determine the influence of land tenure rights on farmers' choice of on-farm adaptation strategies; Let the variable γ_i represent a farmer's decision to adopt a strategy, βx_i be a vector of explanatory (independent) variables and λ_i be the error term associated with the estimated regression model.

$$\gamma_i = \beta + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 + \beta_{10} x_{10} + \beta_{11} x_{11} + \lambda_i$$

Where a farmer's decision is $\gamma_i = 1$ if he/she adopts a strategy and 0 if he/she does not adopt a strategy. See Table 3.3 for coding of the independent variables.

3.3 Summary

This chapter discussed the background of the study area. The aim of this was to give a general insight of the study area based on its physical, economic and social environment.

In addition, the chapter discussed the methodology employed in achieving the objectives of the study. This included the research design, sampling procedure and sample size, types and sources of data, techniques, and tools used in the data collection as well as the techniques employed in processing and analyzing results of the study. The research designed adopted for the study was mixed research design; concurrent triangulation strategy. A reconnaissance survey was conducted in the study area prior to the commencement of the study. The sampling strategy was multistage, purposive, stratified and simple random sampling techniques. Data were collected through household survey, FGDs and key informants interview using, semi-structured questionnaire, FGDs guide and key informants interview guide respectively. Qualitative data were manually analyzed whilst quantitative data were coded and analyzed using SPSS version 21 and Microsoft excel 2010. Statistical techniques such as cross-tabulation, chi square tests and binary logistic regression were employed in the data analysis. The next chapter discusses the results of the study which

include the socio-economic and demographic characteristics, forms of land tenure arrangements, perceived level of farmland tenure security, determinants of farmland tenure security and the influence of land tenure rights on farmers' choice of on-farm adaptation strategies.

CHAPTER FOUR

RESULTS

4.0 Introduction

This chapter presents the results of the study. The chapter is divided into five sections. The first section deals with results on the socio-demographic and farm level characteristics of the respondents (crop farmers). The second section presents results on the forms of land tenure arrangements, whilst the third section provides results on the perceived level of farmland tenure security among the respondents. Results on the determinants of farmland tenure security among the respondents is presented in section four, whilst the influence of land tenure rights on the choice of on-farm adaptation strategies among the respondents is presented in section five.

4.1 Socio-Demographic and Farm Level Characteristics

This section describes the basic socio-demographic and farm level characteristics of the respondents; namely sex, age, marital status, religion, level of education, ancestry and household size (see Table 4.1). The farm level characteristics included annual farm income, distance to farmland, access to agricultural extension services, perceptions of climate change and strategies employed for adaptation. The annual farm income of the respondents was cross-tabulated according to sex (gender), age (youth; 15-45 years and aged; 46 years and above) and ancestry (natives and migrants) in order to compare the annual farm income earned by the respondents. Additionally, Pearson chi square tests were performed to further examine the relationship between the respondents' socio-demographic characteristics (gender, age and ancestry) and amount of annual farm income earned. See Table 4.2.

The study's results reflect an equal representation of the concerns and views of both male and female farmers in the district. There was equal representation of male and female farmers (50%) male and (50%) female.

Of the 192 crop farmers interviewed, most of them (26%) were within the age bracket of 46-55 years. The age group 56-65 years was the second highest (19.3%), followed by the age groups 36-45 years and 26-35 years representing 17.7% and 14.6% respectively. About 11.5% of the respondents were also within the age group, 66 years and above whilst the age group under 25 years recorded the least, representing 10.9%.

Interestingly, about 84.9% of the farmers were married whilst 15.2% were single. The rest of the respondents, representing 1% and 8.9% were farmers who got married before but were divorced and windowed respectively. In terms of religious affiliation, it was reported that most of the farmers (57.3%) were traditional worshipers. The rest of them (33.3%) and 9.4% were Christians and Muslims respectively.

Moreover, many of the farmers interviewed (72.4%) never had formal education. Of those who had formal education, about 15.1% of them had only primary education whilst 6.8% had formal education up to Junior High School or Middle School. Only 3.1% of the farmers had formal education up to Senior High School or Technical School whilst 2.6% had formal education up to the tertiary level. Also, while most of the farmers (93.8%) were found to be natives of the Lawra District, the study area, 6.3% of them were found to be migrants hailing from other parts of the Upper West Region. With regards to household size, the average household size reported in the study area was 9.1 persons per household. Most of the farmers, representing 43.8% and 34.8% had household sizes of more than 10 persons and 6-10 persons respectively. Only 21.4% of them had a household size of 1-5 persons.

Table 4.1 Socio-Demographic Characteristics of respondents

Characteristics		Frequency	Percent
Sex	Male	96	50
	Female	96	50
	Total	192	100
Age	Under 25	21	10.9
	26-35	28	14.6
	36-45	34	17.7
	46-55	50	26
	56-65	37	19.3
	66 and above	22	11.5
	Total	192	100
Marital status	Married	163	84.9
	Single	10	5.2
	Divorced	2	1
	Widowed	17	8.9
	Total	192	100
Religion	Christian	64	33.3
	Islam	18	9.3
	Traditional religion	110	57.3
	Total	192	100
Level of formal education	No formal education	139	72.4
	Primary School	29	15.1
	JHS/Middle School	13	6.8
	SHS/Tech School	6	3.1
	Tertiary School	5	2.6
	Total	192	100
Ancestry	Native (indigene)	180	93.8
	Settler (migrant)	12	6.3
	Total	192	100
Household size	1-5 persons	41	21.4
	6-10 persons	67	34.8
	More than 10 persons	84	43.8
	Total	192	100

Source: Field Survey, 2017

The estimated average annual farm income reported by the farmers was GH¢1215.70. Many of the farmers (60.4%) had an estimated annual farm income of GH¢600.00 to GH¢1200.00. This is made up of 85.4% female farmers and 35.4% of male farmers. Only

1% of female farmers reported of earning more than GH¢1800.00 as annual farm income. Undoubtedly, majority (45%) of male farmers reported that, their annual farm income was more than GH¢1800.00. Also, 5.2% of female farmers earned below GH¢600.00 as estimated annual farm income. Results of a chi square test ($X^2 = 81.665$, $P = 0.000 < 0.01$) showed that there was a very significant relationship between gender and estimated annual farm income of the farmers. On the other hand, about 6.4% of aged farmers earned below GH¢600.00 as annual farm income compared to 3.6% of youth farmers. Whereas many of the youth farmers (61.4%) earned around GH¢600.00 - GH¢1200.00, it was found that, 59.6% of the aged farmers earned the same amount as their annual farm income. Results of a chi square test ($X^2 = 1.647$, $P = 0.649 > 0.05$) showed that there was no any significant relationship between annual farm income and age of farmers. Similarly, there was no any significant relationship between ancestry of the farmers and estimated annual farm income, (see $X^2 = 5.815$, $P = 0.121 > 0.05$) See Table 4.2.

Table 4.2 Estimated Annual Farm Income (GH¢)

Farmer group	Below GH¢600	GH¢600-GH¢1200	GH¢1201-GH¢1800	Above GH¢1800	**Total**	Chi square test
Male	0	34(35.4%)	18(18.8%)	44(45.8%)	96(100%)	$X^2 = 81.665$, $P = 0.000 < 0.01$; df = 3
Female	10(10.4%)	82(85.4%)	3(3.1%)	1(1%)	96(100%)	
Total	10(5.2%)	116(60.4%)	12(10.9%)	45(23.4%)	192(100%)	
Youth	3(3.6%)	51(61.4%)	11(13.3%)	18(21.7%)	83(100%	$X^2 = 1.647$, $P = 0.649 > 0.05$; df = 3
Aged	7(6.4%)	65(59.6%)	10(9.2%)	27(24.8%)	109(100%)	
Total	10(5.2%)	116(60.4%)	12(10.9%)	45(23.4%)	192(100%)	
Indigene (native)	10(5.6%)	105(58.3%)	20(11.1%)	45(25%)	180(100%)	$X^2 = 5.815$,$P = 0.121 > 0.05$;df = 3
Migrant (settler)	0	11(91.7%)	1(8.3%)	0	12(100%)	
Total	10(5.2%)	116(60.4%)	12(10.9%)	45(23.4%)	192(100%)	

Source: Field Survey, 2017

The common types of crops cultivated by the farmers included; vegetables (pepper, okra, tomato etc.), legumes (beans, Bambara beans, soybean, groundnuts etc.), cereals (sorghum, millet, and rice) and tubers (sweet potato). It was ascertained that 2.1% of the farmers

cultivated only vegetables, 3.6% cultivated only legumes, and 3.1% cultivated only cereals whilst 91.1% cultivated more than one type of crop. Regarding the distance that the farmers travel to their farmlands, it was reported that, many of the farmers (84.4%) travel for a distance of less than 2km to their farmlands whilst 15.6% travel for 2km and more before getting to their farmlands.

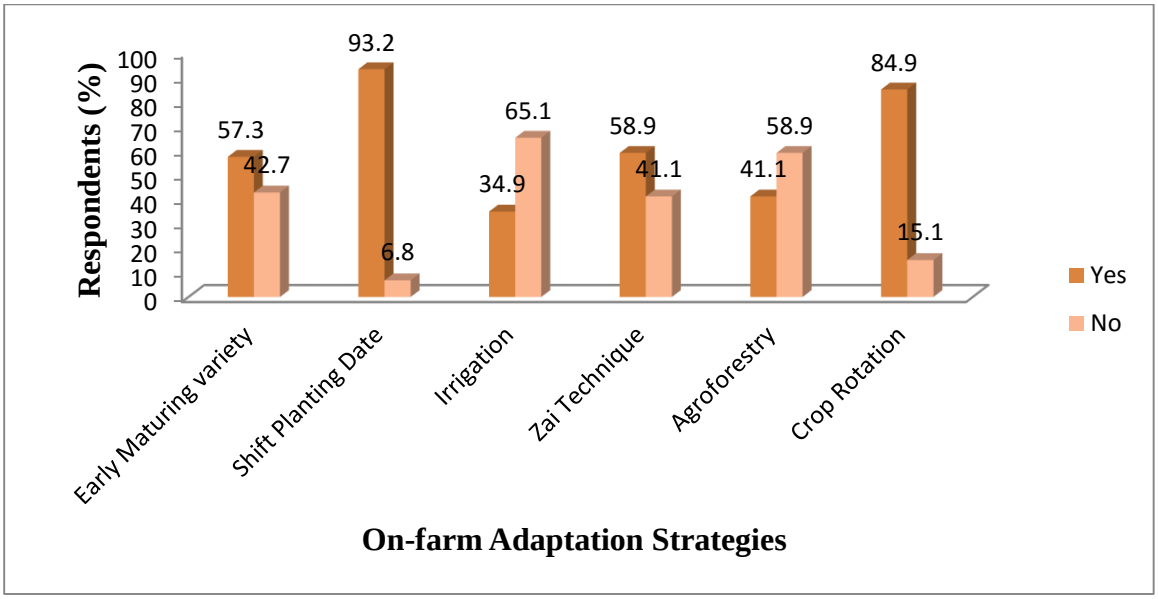
Also, it was found that 51% of the crop farmers interviewed had access to training from agricultural extension agents. However, closed to half (49%) of the farmers reported that, they did not have training from agricultural extension agents that could provide them with the technical expertise that they need for the improvement of their farming activities. This was further disaggregated between the men and women. Indeed, it emerged that a little over half (53.1%) of the male crop farmers had access to agricultural extension service compared to 46.9% of the female crop farmers.

In ascertaining the farmers perception of climate change, spaning from the past one to three decades, about 97.3% of them reported of a decreasing trend in the frequency and amount of rainfall whilst 2.7% reported an increasing trend. Also, majority of the respondents (99.5%) reported of increasing trend in the temperature levels whilst 0.5% of them observed a decreasing trend. The common adaptation strategies employed by the farmers in response to the impacts of climate change included, shifting of planting dates, use of early maturing crop varieties, agroforestry, irrigation, zai farming technique, and crop rotation.

Interestingly, it was found that, about 57.3% of the farmers cultivate early maturing crop varieties as part of their adaptation strategies. However, about 42.7% of the farmers did not use this strategy for adaptation. It also, emerged that majority of the farmers (93.2%) change their planting dates as a way of adapting to the impacts of climate change. As shown in Figure 4.1, about 34.9% of the farmers reported that, they use irrigation as a means of

watering their crops during periods of drought or inadequate rainfall. However, majority of the farmers (65.1%) did not use irrigation as a strategy for adaptation due to lack of irrigation schemes in their various communities. Another strategy that was well known in the study area is the zai farming technique. The zai farming technique is an indigenous climate smart agricultural practices that originated from Burkina Faso. It involves the digging of holes in farmlands in order to contain running soil water and to retain nutrients in the farmland. It emerged that, more than half (58.9%) of the farmers use the zai farming technique as an adaptation strategy to increase productivity in their farms. The rest of the farmers (41.1%) however, did not employ this technique as part of their adaptation strategies.

Figure 4.1 On-farm Adaptation Strategies of Farmers



Source: Field Data, 2017

Also, adoption of agroforestry as an adaptation strategy was low among most of the farmers surveyed. About 58.9% of the farmers reported that they did not employ agroforestry as a strategy for adaptation. However, about 41.1% of the farmers adopted agroforestry as part of their adaptation strategies. With regards to the use of crop rotation, majority (84.9%) of

the farmers reported that, they use crop rotation as part of their adaptation strategies by mostly rotating cereal crops with legumes and tubers in every two to four cropping seasons. See Figure 4.1.

4.2.0 Forms of Land Tenure Arrangements

The mode of land tenure arrangements has the tendency to influence farmers' perception about their land tenure security and adaptation decisions. To achieve this, this section presents results on the forms of land tenure arrangement among the respondents which include; farmland size, mode of land acquisition and the types of tenure rights that the respondents hold to their farmland (s). It also presents results with regards to the levels of land decision making. Results on the size of farmland, mode of land acquisition and types of land holding rights among the surveyed farmers were obtained through cross-tabulations with the gender (sex), age and ancestry of the farmers. Further, chi square tests were performed to add more meaning to the results obtained from the cross-tabulation.

4.2.1 Size of farmland

A significant variable that could not have been left out in this study is the size of farmland among the respondents. It was reported in the study that, almost two-third (64.6%) of the 192 farmers surveyed, owned less than 6 acres of farmland. As it is usually the case, gender inequality with respect to size of farmland was very significant. As indicated in Table 4.3, an overwhelming majority of female farmers (99%) interviewed, owned below 6 acres of farmland. This is contrary to their male counterparts where only 30.2% of them, owned farmland below 6 acres. The average, size of farmland among the farmers studied was reported to be 4.6 acres. It also emerged that, 55.2% of male crop farmers owned 6-10 acres of farmland compared to only 1% of female farmers. Again, while 14.6% of male farmers owned more than 10 acres of farmland, none of the female farmers interviewed owned more than 10 acres of farmland. Results of a chi square test ($X^2 = 99.203$, $P = 0.000 < 0.01$)

showed that there was a significant relationship between gender and size of farmland. With regards to age, it was found that, about 69.9% of farmers considered to be youth, owned below 6 acres of farmland whilst 60.6% of aged farmers owned below 6 acres. Whereas 22.9% and 7.2% of youth farmers owned 6-10 acres and above 10 acres of farmland respectively, 32.1% and 7.3% of aged farmers owned 6-10 acres and above 10 acres respectively. With regards to farmers who were indigenes (natives) and settlers (migrants), about 62.8% of native farmers owned below 6 acres of farmland whilst 91.7% of the migrant farmers owned below 6 acres. About 29.4% and 7.8% of native farmers owned 6-10 acres and above 10 acres of farmland respectively but only 8.3% of migrant farmers owned 6-10 acres. None of the settler farmers owned up to 10 acres of farmland and above. However, results of a chi square test ($X^2 = 2.06$, $P = 0.357 > 0.05$) showed that, there was no any significant relationship between age and size of farmland. Similarly, there was no any significant relationship between ancestry of farmers and the size of their farmland (see $X^2 = 4.170$, $P = 0.124 > 0.05$).

Table 4.3 Size of Farmland in Acres

Farmer group	Below 6 acres	6-10 acres	Above 10 acres	**Total**	Chi square test
Male	29(30.2%)	53(55.2%)	14(14.6%)	96(100%)	$X^2 = 99.203$, $P = 0.000 < 0.01$; df = 2
Female	95(99%)	1(1%)	0	96(100%)	
Total	124(64.6%)	54(28.1%)	14(7.3%)	192(100%)	
Youth	58(69.9%)	19(22.9%)	6(7.2%)	83(100%	$X^2 = 2.060$, $P = 0.357 > 0.05$; df = 2
Aged	66(60.6%)	35(32.1%)	8(7.3%)	109(100%)	
Total	124(64.6%)	54(28.1%)	14(7.3%)	192(100%)	
Indigene (native)	113(62.8%)	53(29.4%)	14(7.8%)	180(100%)	$X^2 = 4.170$, $P = 0.124 > 0.05$;df = 2
Migrant (settler)	11(91.7%)	1(8.3%)	0	12(100%)	
Total	124(64.6%)	54(28.1%)	14(7.3%)	192(100%)	

Source: Field Data, 2017

4.2.2 Mode of Land Acquisition

As shown in Table 4.4, the study found that, in every cropping season, majority of the farmers (50.5%) rely on their relatives to access land for farming whilst 36.5% of them cultivate on lands that they inherited from their fathers. Interestingly, 2.6% of the farmers reported that, it is their friends who give them land as gift for farming whilst 10.4% said they acquire their farmlands through leasehold arrangements. This data was further cross-tabulated and disaggregated based on gender, age and ancestry. On the basis of gender, it emerged that majority of male crop farmers (71.9%) acquired their farmlands through inheritance whilst 9.4% of them acquired their farmlands as grants from family members. Beyond inheritance, 17.7% of them acquired their farmlands through leasehold arrangements, whilst 1% of them got their farmlands through gifts. With regards to the female farmers, an overwhelming majority of them (91.7%) reported that they normally borrow lands from their relatives for farming purposes. Only 1% of the female farmers reported that, they acquired their farmlands through inheritance. The rest of them (4.2% and 3.1%) respectively reported that, they acquired their farmlands through gift and leasehold arrangements. These findings are complemented by results of a chi square test (X^2 = 141.997, P = 0.000 < 0.01) that was ran. The test confirmed a very significant relationship between gender and mode of land acquisition. This was also confirmed during FGDs with female crop farmers at Pavuu; *"As women, we do not inherit land from our fathers, when we need land to farm; we beg our husbands or family members who can give us a portion of their land to farm" (FGDs, 2017).*

It was also found that, 50.6% of youth crop farmers acquired their farmlands through borrowing from their relatives whilst 38.6% acquired theirs through inheritance. The rest of the youth crop farmers, 3.6%, and 7.2% also acquired their farmlands through gift and leasehold. With regards to the aged crop farmers, about 50.5% of them acquired their

farmlands through grants from relatives and family members whereas 34.9% acquired theirs through inheritance. Some of the aged crop farmers representing 1.8% and 12.8% got their farmlands through gift and leasehold respectively. About 37.2% of native crop farmers acquired their farmlands through inheritance compared to 25% of migrant farmers. Again, many migrant crop farmers (66.7%) acquired their farmlands through borrowing compared to 49.4% of native crop farmers. However, there was no any significant relationship between age of farmers and mode of farmland acquisition as well as ancestry and mode of farmland acquisition. See Table 4.4.

Table 4.4 Mode of Land Acquisition

Farmer group	Inheritance	Gift	Leasehold	Borrowed from relative	**Total**	Chi square test
Male	69(71.9%)	1(1%)	17(17.7%)	9(9.4%)	96(100%)	X^2 = 141.997, P = 0.000 < 0.01; df = 3
Female	1(1%)	4(4.2%)	3(3.1%)	88(91.7%)	96(100%)	
Total	70(36.5%)	5(2.6%)	20(10.4%)	97(50.6%)	192(100%)	
Youth	32(38.6%)	3(3.6%)	6(7.6%)	42(50.6%)	83(100%	X^2 = 2.176, P = 0.537 > 0.05; df = 3
Aged	38(34.9%)	2(1.8%)	14(12.8%)	55(50.5%)	109(100%)	
Total	70(36.5%)	5(2.6%)	20(10.4%)	97(50.6%)	192(100%)	
Indigene (native)	67(37.2%)	4(2.2%)	20(11.1%)	89(49.4%)	180(100%)	X^2 = 4.068, P = 0.254 > 0.05;df = 3
Migrant (settler)	3(25%)	1(8.3%)	0	8(66.7%)	12(100%)	
Total	70(36.5%)	5(2.6%)	20(10.4%)	97(50.6%)	192(100%)	

Source: Field Data, 2017

4.2.3 Types of Land Rights

With respect to the common types of land tenure rights among the surveyed crop farmers, a little over half (54.7%) of the farmers had only user rights to their farmlands whilst 35.9% of them had transfer (complete) rights. Only 9.4% of them had control rights over their farmlands. Again, the data was further cross-tabulated and disaggregated based on gender,

age and ancestry. Indeed, it emerged from the results that, an overwhelming majority (97.9%) of female farmers only had user rights to their farmlands compared to only 11.5% of male crop farmers who were reported to have only user rights to their farmlands. See Table 4.5. Moreover, about 17.7% of male crop farmers had control rights to their farmlands compared to 1% of their female counterparts. Those who had transfer rights to their farmlands comprised of 70.8% of male crop farmers and 1% of female crop farmers. Majority of the female farmers bemoaned that; "as *women we cannot do anything with the land given to us by our husbands or family members apart from growing crops on it" (women FGDs, 2017).*

Table 4.5 Types of Land Tenure Rights

Farmer group	User rights	Control rights	Transfer rights	**Total**	Chi square test
Male	11(11.5%)	17(17.7%)	68(70.8%)	96(100%)	X^2 = 144.890, P = 0.000 < 0.01; df = 2
Female	94(97.9%)	1(1%)	1(1%)	96(100%)	
Total	105(54.7%)	18(9.4%)	69(35.9%)	192(100%)	
Youth	45(54.2%)	6(7.2%)	32(38.6%)	83(100%	X^2 = 1.003, P = 0.606 > 0.05; df = 2
Aged	60(55%)	12(11%)	37(33.9%)	109(100%)	
Total	105(54.7%)	18(9.4%)	69(35.9%)	192(100%)	
Indigene (native)	96(53.3%)	18(10%)	66(36.7%)	180(100%)	X^2 = 2.592, P = 0.274 > 0.05;df = 2
Migrant (settler)	9(75%)	0	3(25%)	12(100%)	
Total	105(54.7%)	18(9.4%)	69(35.9%)	192(100%)	

Source: Field Data, 2017

Also, as shown in Table 4.5, about 54.2% of youth crop farmers were reported to have only user rights to their farmlands compared to 55% of aged crop farmers. With regards to having control over farmlands, about 7.2% of youth crop farmers had control rights to their

farmlands compared to 11% of aged crop farmers. Again, about 38.6% of youth farmers had transfer rights to their farmlands compared to 33.9% of aged crop farmers. Furthermore, land rights varied between native and migrant farmers. For instance, about 53.3% of native crop farmers had only user rights to their farmlands compared to 75% of migrant crop farmers. It was also reported that about 36.7% of native farmers had transfer rights to their farmlands compared to 25% of migrant farmers. With respect to having control rights over farmlands, 10% of native crop farmers asserted they had control rights over their farmlands. None of the migrant crop farmers had control rights over their farmlands. Whereas results of a chi square test showed there was a significant relationship between gender and type of land tenure rights, there was no any significant relationship between age and type of land tenure rights as well as ancestry of crop farmers and type of land tenure rights respectively.

4.2.4 Levels of Land Decision Making

In ascertaining the levels at which decisions are mostly taken with respect to land tenure arrangement among farmers in the district, majority of the surveyed farmers (94.8%) reported that, decision making regarding land tenure arrangement in their communities is taken at various family levels whilst 5.2% of them were of the view that decision making regarding land tenure arrangement is normally taken at the clan level.

4.3 Perceived Level of Farmland Tenure Security

This section presents results on farmers' perceived level of their farmland tenure security. Perceived farmland tenure security was measured based on Hollingsworth (2014) indicators for measuring perceived land tenure security which were adopted and slightly modified in terms of wording for purpose of understanding by the respondents. These indicators include; perception of future loss of farmland if allowed to fallow, recognition as right holder of farmland by state, traditional land administrative authority or local community,

absence of encroachment on farmland, authority to use land as a collateral and absence of land conflict. The respondents were asked questions based on these indicators in order to ascertain their perceptions of their land tenure security. See results in Figure 4.2. Finally, the farmers overall perceived level of their farmland tenure security was rated in a four point likert scale such as; no tenure security, minimum tenure security, moderate tenure security and maximum tenure security in order to give a summary of the farmers' perceived level of their farmland tenure security with respect to three aspects of their socio-demographic characteristics (gender, age and ancestry).

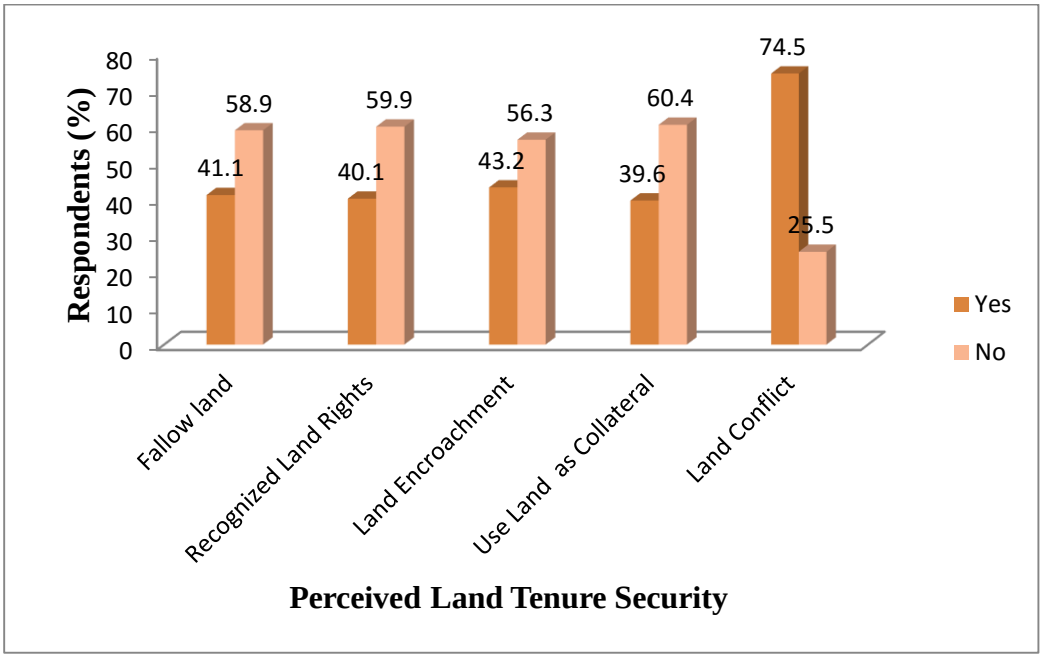
A little over half (58.9%) of the farmers were of the view that, they will lose their farmlands if they allow it to fallow whilst 41.1% of them reported they will not lose their farmlands if allowed to fallow. See Figure 4.2. This was further supported by some concerns that were raised during a FGDs; *"We beg for the land from our husbands or relatives so we cannot leave the lands to fallow", (women FGDs, 2017).*

As illustrated in Figure 4.2, about 59.9% of the farmers reported not being legally recognized by traditional heads of their communities as rightful owners of their farmlands. However, about 40.1% of them affirmed that, they were legally recognized by traditional heads of their communities as rightful owners of their farmlands. This was confirmed during a key informant interview; *"because of the cultural norms of this community, women are not legally recognized by custom as owners of the lands that they farm", (Key informant, 2017).*

Interestingly, majority of the farmers (56.3%) reported that, their farmlands were safe from encroachment. However, 43.2% of them bemoaned their farmlands were prone to encroachment. With respect to farmers authority over the use of their farmlands as collateral, a greater proportion of them (60.4%) reported that they had no authority to use

their farmlands as collateral whilst a few of them (39.6%) affirmed they had the authority to use their farmlands as collateral. Also, an overwhelming majority (74.5%) of the farmers affirmed that, they do not anticipate any conflict with regards to their farmlands. However, about 25.5% of them admitted that they were likely to experience conflicts with regards to their farmlands. See Figure 4.2.

Figure 4.2 Perceptions of Land Tenure Security among crop farmers



Source: Field Data, 2017

In ascertaining the general perception of the surveyed farmers about the level of their farmland tenure security, 15.6% of them bemoaned that they had no tenure security with respect to their farmlands whilst 35.9% affirmed having a maximum level of tenure security. Also, 41.1% of the farmers reported, that they had minimum level of tenure security whereas 7.3% said they had moderate level of tenure security. Out of the 35.9% of farmers who reported of having maximum tenure security, only 2.1% of them were female whilst the rest were men. Majority of women farmers were either not tenured secure, had minimum tenure security or moderate tenure security. This is complemented by results of a

chi square test ($X^2 = 95.970$, $P = 0.000 < 0.01$) which showed a very significant relationship between gender and perceived level of farmland tenure security. See Table 4.6. This assertion was corroborated during a key informant interview with an agricultural extension officer in charge of the surveyed communities; *"male farmers have better land tenure arrangements so they have maximum tenure security than the women" (Key informant, 2017).*

Table 4.6 Generally Perceived Level of Farmland Tenure Security

Farmer group	No tenure security	Minimum tenure security	Moderate tenure security	Maximum tenure security	**Total**	Chi square test
Male	8(8.3%)	17(17.7%)	4(4.2%)	67(69.8%)	96(100%)	$X^2 = 95.970$, P =0.000 < 0.01; df = 3
Female	22(22.9%)	62(61.6%)	10(10.4%)	2(2.1%)	96(100%)	
Total	30(15.6%)	79(41.1%)	14(7.3%)	69(35.9%)	192(100%)	
Youth	14(15.1%)	39(41.9%)	6(6.5%)	34(36.6%)	83(100%)	X^2 =1.166, P = 0.761 > 0.05; df = 3
Aged	16(16.2%)	40(40.4%)	8(8.1%)	35(35.4%)	109(100%)	
Total	30(15.6%)	79(41.1%)	14(7.3%)	69(35.9%)	192(100%)	
Native	27(15%)	74(41.1%)	13(7.2%)	66(36.7%)	180(100%)	X^2 =1.166, P = 0.761 > 0.05; df = 3
Settler (migrant)	3(25%)	5(41.7%)	1(8.3%)	3(25%)	12(100%)	
Total	30(15.6%)	79(41.1%)	14(7.3%)	69(35.9%)	192(100%)	
Native female	19(21.8%)	57(65.5%)	9(1.1%)	2(1.1%)	87(100%)	$X^2 = 0.807$, P = 0.848 > 0.05; df = 3
Migrant female	3(33.3%)	5(55.6%)	1(11.1%)	0	9(100%)	
Total	22(22.9%)	62(64.6%)	10(10.4%	2(2.1%)	96(100%)	

Source: Field Data, 2017

Also, on the part of other farmer groups such as migrant and youth farmers, the perceived leve of farmland tenure security did not differ significantly between native and migrant

farmers as well as between youth farmers and aged farmers. Furthermore, in trying to determine the perceived level of land tenure security between native female farmers and migrant female farmers, it was reported that more native female farmers were perceived to have tenure security over their farmlands than their migrant counterparts. For instance, about 33.3% of migrant female farmers reported not to have tenure security over their farmlands compared to only 21.8% of native female farmers who reported of not having tenure security over their farmlands. Also, whilst 1.1% of native female farmers reported of having maximum tenure security over their farmlands, none of the migrant female farmers had maximum tenure security over their farmlands. However, results of a chi square test (see Table 4.6) proved that there was no any significant difference between native female farmers and that of migrant female farmers with regards to the level of land tenure security.

4.4 Determinants of Farmland Tenure Security

Farmland tenure security is the perceived probability or likelihood of a farmer not losing his/her access to and control over parts or whole of his/her farmland to any person or party without his/her own consent (Alemu, 1999). Farmers' decision to fallow their farmlands was used as a proxy indicator of farmland tenure security (dependent variable), see Ayamga et al. (2015) and Hollingsworth (2014) who argued that, a tenure insecure farmer would continue to cultivate his/her land instead of fallowing it, but a secure right holder may decide to leave his/her land idle without fear of appropriation. The dependent variable (tenure security) was regressed against the socio-economic and demographic characteristics (independent variables) using binary logistic regression in order to identify the significant variables that determine farmland tenure security among the farmers.

It was found that, only 41.1% of the farmers surveyed were tenure secure. From the binary logistic regression, the main determinants of farmland tenure security were; age, sex (gender), and type of land tenure rights (see Table 4.7). The binary logistic regression

model gave a Pseudo R^2 value of 0.787 which implies that about 78.7% of the variation in the probability of farmers being tenure secure is explained by all the independent variables included in the model.

Table 4.7 Determinants of Farmland Tenure Security

	Odd Ratio	Std. Err	P-value
Age			
Youth (reference category)	1.000		
Aged	3.878	0.693	0.051**
Sex			
Male (reference category)	1.000		
Female	0.136	0.953	0.036**
Educational level			
Lower than JHS/Middle Sch. (reference category)	1.000		
JHS/Middle Sch or higher	4.601	0.930	0.101
Ancestry			
Indigene/native (reference category)	1.000		
Settler (migrant)	0.406	1.146	0.431
Land tenure rights			
User rights (reference category)	1.000		
Control rights	0.498	0.995	0.483
Transfer rights	115.885	0.979	0.000*
Household size			
1-5 members (reference category)	1.000		
6-10 members	0.745	0.634	0.642
More than 10 members	0.174	1.042	0.093***
Farm size			
Up to 5 acres (reference category)	1.000		
Above 5 acres	3.184	0.857	0.176
Distance to farmland			
Less than 2km (reference category)	1.000		
2km and above	3.981	1.046	0.187
Model P-value = 0.015, Pseudo R^2 = 0.787, N = 192			

Note: *, ** and *** represent significant values at 1%, 5% and 10% respectively.

From Table 4.7, it is reported that, if other factors were controlled, women farmers were about 7 times less likely to be tenure secure compared to their male counterparts. Also, farmers who were categorized as aged (46 years and above) were about 4 times more likely

to be tenure secure compared to youth farmers (15-45 years). Furthermore, tenure security among the farmers was largely influenced by the type of land rights. For instance, farmers who had transfer rights to their farmlands were about 116 times more likely to be tenure secure compared to those who had only user rights.

4.5 Influence of Land Tenure Rights on Farmers' Choice of Adaptation Strategies

This section presents the results of a binary logistic regression aimed at determining the influence of land tenure rights on farmers' choice of on-farm adaptation strategies. This was achieved through the use of a binary logistic regression model. Farmers' choice of a strategy (see Figure 4.1) was treated as the dependent (outcome) variable whilst types of land tenure rights including farmers' socio-economic and demographic characteristics were used as the independent (predictor) variables. The inclusion of the socio-economic and demographic variables was to statistically determine the influence of land tenure rights on farmers' adaptation decisions when compared with other socio-economic and demographic variables of the farmers. In all, six binary logistic regression models were run based on six common adaptation strategies adopted by the crop farmers.

As shown in Table 4.8, the main determinants of the use of early maturing crop varieties as an adaptation strategy were the household size of the farmers and access to agricultural extension services. The binary logistic regression model was very significant at 5% level of significance but was, however, not very strong. Thus, the model gave a Pseudo R^2 value of 0.228 which implies that about 22.8% of the variation in the probability of farmers adopting early maturing crop varieties as a strategy for adaptation is explained by all the independent variables included in the model. When other factors are controlled, farmers whose household sizes were more than 10 persons were about 3 times more likely to adopt early maturing crop varieties for adaptation compared to those whose household sizes were 1-5 persons. Also, farmers who had access to agricultural extension services were about 2 times

more likely to cultivate early maturing crop varieties as part of their adaptation strategies than those without agricultural extension services.

Table 4.8 Determinants of the use of Early Maturing Crop Varieties

		Odd Ratio	Std.Err	P-value
Location	Pavuu (reference category)	1.000		
	Tolibri	2.804	0.478	0.131
	Kalsagre	1.899	0.465	0.168
	Brewong	1.205	0.459	0.684
Sex	Male (reference category.)	1.000		
	Female	0.523	0.774	0.402
Age	Youth (reference category.)	1.000		
	Aged	1.157	0.329	0.657
Household	1-5 persons (reference category.)	1.000		
size	6-10 persons	0.544	0.373	0.103
	More than 10 persons	3.268	0.534	0.027**
Ancestry	Indigene (reference category.)	1.000		
	Migrant	1.816	0.708	0.400
Land size	Below 6 acres (reference category.)	1.000		
	6-10 acres	0.669	0.530	0.449
	Above 10 acres	1.785	0.850	0.496
Tenure	User rights (reference category.)	1.000		
rights	Control rights	0.843	0.792	0.829
	Transfer rights	1.354	0.692	0.661
Extension	Have access (reference category.)	1.000		
services	Have no access	2.052	0.334	0.031**
Rainfall	Increasing (reference category.)	1.000		
	Decreasing	0.927	1.075	0.944
Temperature	Increasing (reference category.)	1.000		
	Decreasing	0.000	21948.091	0.999
Model P-value =0.044, Pseudo R^2=0.228, N=192				

Note; ** shows significant levels at 5%.

Table 4.9 Determinants of Shifting Planting Date

Variables		Odd Ratio	Std.Err	P-value
Location	Pavuu (reference category)	1.000		
	Tolibri	2.267	0.857	0.340
	Kalsagre	3.242	0.900	0.191
	Brewong	12.462	1.193	0.034**
Sex	Male (reference category)	1.000		
	Female	0.019	3.962	0.319
Age	Youth (reference category)	1.000		
	Aged	0.404	0.711	0.203
Household	1-5 persons (reference category)	1.000		
size	6-10 persons	0.679	0.724	0.593
	More than 10 persons	5.657	0.1.185	0.144
Ancestry	Indigene (reference category.)	1.000		
	Migrant	1.261	1.282	0.706
Land size	Below 6 acres (reference	1.000		
	category)	0.029	3.862	0.361
	6-10 acres	0.003	4.023	0.148
	Above 10 acres			
Tenure	User rights (reference category)	1.000		
rights	Control rights	267930352.8	8256.479	0.998
	Transfer rights	2.084	1.300	0.572
Extension	Have access (reference category)	1.000		
services	Have no access	2.887	0.717	0.139
Rainfall	Increasing (reference category)	1.000		
	Decreasing	19384575.40	16673.752	0.999
Temperature	Increasing (reference category)	1.000		
	Decreasing	0.000	20253.323	0.999
Model P-value =0.000, Pseudo R^2 =0.291, N=192				

Note; ** indicates significant values at 5%

As shown in Table 4.9, the regression model showed that, the main determinant of farmers' decision to change their planting dates as an adaptation strategy was their location. The binary logistic regression model gave a Pseudo R^2 value of 0.291 which implies that about 29.1% of the variation in the probability of farmers changing their planting dates as a strategy for adaptation is explained by all the independent variables included in the model. When other factors are controlled, farmers from Brewong were about 13 times more likely to change their planting dates compared to those from Pavuu.

Irrigation is widely acknowledged as one of the most preferred adaptation strategies among farmers in semi-arid regions (Bawakyillenuo et al., 2016). Based on results of a binary logistic regression model, location of the farmers surveyed, was found to be very significant in determining the use of irrigation as an adaptation strategy by the farmers. The binary logistic regression model was very significant at 1% but gave a Pseudo R^2 value of 0.514 which implies that about 51.4% of the variation in the probability of farmers adopting irrigation as a strategy for adaptation is explained by all the independent variables included in the model. If all other factors are controlled, farmers from Tolibri were about 248 times more likely to employ the use of irrigation as an adaptation strategy compared to farmers from Pavuu. Also, farmers from Kalsagre were about 12 times more likely to adopt the use of irrigation as an adaptation strategy compared to their counterparts at Pavuu. Similarly, farmers from Brewong were about 44 times more likely to adopt irrigation compared to farmers from Pavuu. See Table 4.10.

Table 4.10 Determinants of Adoption of Irrigation

Variables		Odd Ratio	Std.Err	P-value
Location	Pavuu (reference category)	1.000		
	Tolibri	247.437	1.115	0.000*
	Kalsagre	11.705	1.108	0.026**
	Brewong	44.124	1.076	0.000*
Sex	Male (reference category)	1.000		
	Female	0.587	0.956	0.577
Age	Youth (reference category)	1.000		
	Aged	1.600	0.416	0.885
Household size	1-5 persons (reference category)	1.000		
	6-10 persons	0.823	0.518	0.707
	More than 10 persons	1.840	0.618	0.324
Ancestry	Indigene (reference category.)	1.000		
	Migrant	0.888	0.821	0.885
Land size	Below 6 acres (reference category)	1.000		
	6-10 acres	1.409	0.648	0.597
	Above 10 acres	0.726	0.976	0.742
Tenure rights	User rights (reference category)	1.000		
	Control rights	1.296	0.940	0.782
	Transfer rights	0.553	0.857	0.489
Extension services	Have access (reference category)	1.000		
	Have no access	0.634	0.425	0.283
Rainfall	Increasing (reference category)	1.000		
	Decreasing	0.000	16903.461	0.999
Temperature	Increasing (reference category)	1.000		
	Decreasing	1.421	1.604	0.827
Model P-value = 0.000, Pseudo R^2 = 0.514				

Note: * and ** represent significant values at 1% and 5% respectively

Table 4.11 Determinants of Adoption of Zai Farming

Variables		Odd Ratio	Std.Err	P-value
Location	Pavuu (reference category)	1.000		
	Tolibri	0.431	0.509	0.098***
	Kalsagre	0.295	0.521	0.019**
	Brewong	0.289	0.503	0.013**
Sex	Male (reference category)	1.000		
	Female	0.088	0.904	0.007*
Age	Youth (reference category)	1.000		
	Aged	1.567	0.342	0.191
Household size	1-5 persons (reference category)	1.000		
	6-10 persons	1.054	0.400	0.895
	More than 10 persons	0.806	0.492	0.662
Ancestry	Indigene (reference category)	1.000		
	Migrant	1.415	0.720	0.629
Land size	Below 6 acres (reference	1.000		
	category)	0.226	0.728	0.041**
	6-10 acres	0.139	0.897	0.028**
	Above 10 acres			
Tenure rights	User rights (reference category)	1.000		
	Control rights	1.744	0.844	0.510
	Transfer rights	1.533	0.724	0.555
Extension	Have access (reference category)	1.000		
services	Have no access	1.888	0.359	0.077***
Rainfall	Increasing (reference category)	1.000		
	Decreasing	1.303	1.045	0.800
Temperature	Increasing (reference category)	1.000		
	Decreasing	2.507	1.460	0.529
Model P-value = 0.015, Pseudo R^2 = 0.288				

Note: *, ** and *** represent significant values at 1%, 5% and 10% respectively.

Zai farming is one of the climate smart agricultural practices which originated from Burkina Faso and Niger. It involves the digging of holes in farmlands in order to contain running water and to retain nutrients in the soil. A binary logistic regression model indicated that farmers' location, gender (sex) and size of farmland were the very significant determinants of adoption of zai farming technique among farmers for adaptation. The model was very

significant at 5% and gave a Pseudo R^2 value of 0.288 which implies that all the independent variables included in the model only explained about 28.8% of variation in the probability of farmers adopting zai farming technique as a strategy for adaptation. If all other factors are controlled, famers from Kalsagre were about 3 times less likely to employ the use of zai farming than their colleagues at Pavuu. Similarly, farmers at Brewong were about 4 times less likely to adopt zai farming technique as an adaptation strategy compared to those at Pavuu. Also, female farmers were about 11 times less likely to practice zai farming for adaptation compared to male farmers. With respect to the size of farmland, farmers who owned about 6-10 acres of farmland were about 4 times less likely to adopt zai farming technique for adaptation compared to those who owned below 6 acres of farmland. Also, farmers who owned more than 10 acres of farmland were about 10 times less likely to adopt zai farming technique for adaptation. See Table 4.11.

The use of agroforestry as an adaptation strategy is widely recognized as effective in improving crop productivity in semi-arid areas. From the binary logistic regression in Table 4.12, the location of the farmers and their sex (gender) were significant determinants of adoption of agroforestry. The logistic regression model was strong with a Pseudo R^2 value of 0.503 which means that all the independent variables included in the model only explained about 50.3% of the variation in the probability of farmers adopting agroforestry as a strategy for adaptation. Compared to farmers from Pavuu, farmers from Tolibri were about 17 times more likely to adopt agroforestry for adaptation if other factors are controlled. Moreover, farmers from Kalsagre were also about 5 times more likely to adopt agroforestry than farmers from Pavuu whilst farmers from Brewong were about 8 times more likely to adopt agroforestry compared to their counterparts at Pavuu. Female farmers were also about 7 times less likely to adopt agroforestry for adaptation compared to their male counterparts.

Table 4.12 Determinants of Adoption of Agroforestry

Variables		Odd Ratio	Std.Err	P-value
Location	Pavuu (reference category)	1.000		
	Tolibri	17.109	0.649	0.000*
	Kalsagre	4.563	0.658	0.021**
	Brewong	8.157	0.630	0.001*
Sex	Male (reference category)	1.000		
	Female	0.135	0.862	0.020**
Age	Youth (reference category)	1.000		
	Aged	2.138	0.413	0.066***
Household size	1-5 persons (reference category)	1.000		
	6-10 persons	0.868	0.474	0.766
	More than 10 persons	0.741	0.591	0.613
Ancestry	Indigene (reference category.)	1.000		
	Migrant	0.841	0.831	0.835
Land size	Below 6 acres (reference category)	1.000		
	6-10 acres			
	Above 10 acres	0.345	0.602	0.077***
		5.471	1.242	0.171
Tenure rights	User rights (reference category)	1.000		
	Control rights	4.177	0.915	0.118
	Transfer rights	2.792	0.762	0.178
Extension	Have access (reference category)	1.000		
services	Have no access	1.197	0.410	0.661
Rainfall	Increasing (reference category)	1.000		
	Decreasing	4.977	1.374	0.243
Temperature	Increasing (reference category)	1.000		
	Decreasing	1.080	1.439	0.957
Model P-value = 0.015, Pseudo R^2 = 0.503				

Note: *, ** and *** represent significant values at 1%, 5% and 10% respectively.

As shown in Table 4.13, it was found that, ancestry, farmland size and land tenure rights of the surveyed farmers were significant determinants of adoption of crop rotation for adaptation. The logistic regression model was very weak in that, it gave a Pseudo R^2 value of 0.299 which implies that all the independent variables included in the model only explained about 29.9% of the variation in the probability of farmers adopting crop rotation as a strategy for adaptation.

Table 4.13 Determinants of Adoption of Crop Rotation

Variables		Odd Ratio	Std.Err	P-value
Location	Pavuu (reference category)	1.000		
	Tolibri	1.639	0.655	0.450
	Kalsagre	4.015	0.739	0.060***
	Brewong	4.302	0.776	0.060***
Sex	Male (reference category)	1.000		
	Female	0.801	1.136	0.845
Age	Youth (reference category)	1.000		
	Aged	0.617	0.510	0.344
Household size	1-5 persons (reference	1.000		
	category)	1.180	0.628	0.793
	6-10 persons	0.624	0.587	0.423
	More than 10 persons			
Ancestry	Indigene (reference	1.000		
	category.)	5.579	0.823	0.037**
	Migrant			
Land size	Below 6 acres (reference	1.000		
	category)			
	6-10 acres	0.519	1.148	0.568
	Above 10 acres	0.065	1.259	0.030**
Tenure rights	User rights (reference	1.000		
	category)			
	Control rights	704689684.306	8585.453	0.998
	Transfer rights	7.230	0.917	0.031**
Extension	Have access (reference	1.000		
services	category)	1.437	0.533	0.496
	Have no access			
Rainfall	Increasing (reference	1.000		
	category)	324765392.3	15472.656	0.999
	Decreasing			
Temperature	Increasing (reference	1.000		
	category)	5.713	1.452	0.230
	Decreasing			

Model P-value = 0.000, Pseudo R^2 = 0.299

Note: ** and *** represent significant values at 5% and 10% respectively.

If all other factors were controlled, migrant farmers were about 6 times more likely to adopt crop rotation for adaptation compared to indigene farmers. Similarly, farmers who had transfer rights to their farmlands were about 7 times more likely to practice crop rotation for

adaptation compared to farmers who had only user rights to their farmlands. However, farmers who owned more than 10 acres of farmland were about 15 times less likely to adopt crop rotation as an adaptation strategy compared to those who owned below 6 acres of farmland. See Table 4.13.

4.6 Summary

This chapter presents the results of the study which include the demographic and farm level characteristics, forms of land tenure arrangements, perceived level of farmland tenure security, determinants of farmland tenure security and the influence of land tenure rights on the choice of on-farm adaptation strategies among the respondents. The results of the study generally showed that forms of land tenure arrangements varied significantly among the respondents especially in the case of gender. It was surprising to find that more than half of the respondents (64.6%) owned less than 6 acres of farmland. This was largely made up of female farmers and migrant farmers. There was no secure land acquisition arrangement for about 50.6% of the farmers as this proportion of the farmers reported land borrowing as the means of acquiring land for farming. It was further found that a little over half (54.7%) of the farmers had only user rights to their farmlands. This was largely made up of female farmers. Most of the farmers (41.1%) perceived they had a minimum level of tenure security. Only 35.9% of the farmers had a maximum level of tenure security. Major determinants of farmland tenure security among the farmers included sex (gender), age and types of land rights. Land tenure rights had a significant influence on the farmers' adaption decisions only in the case of two strategies that were adopted by the farmers. The next chapter presents discussions on the key results based on the objectives of the study.

CHAPTER FIVE

DISCUSSION OF RESULTS

5.0 Introduction

This chapter discusses key results based on the objectives of the study. It discusses the common forms of land tenure arrangements among the respondents (crop farmers) and their perceived level of farmland tenure security. It also discusses the determinants of farmland tenure security among the respondents and finally, the influence of land tenure rights on the choice of on-farm adaptation strategies among the respondents.

5.1 Forms of Land Tenure Arrangements

This section discusses the forms of land tenure arrangements among the respondents which include; the size of farmland, mode of land acquisition, types of tenure rights among the respondents and heads of land allocation and decision making.

5.1.1 Size of Farmland

It was reported in the study that, almost two-third (64.6%) of the farmers owned less than 6 acres of farmland. Sadly, an overwhelming majority (99%) of female farmers were part of those who owned less than 6 acres of farmland compare to only 30.2% of male farmers. This is consistent with Pérez et al. (2015) who found in parts of East and West Africa including the Lawra District of Upper West Region of Ghana that, women farmers were cultivating on smaller land parcels compared to the male farmers. Indeed, this phenomenon was not just a gender issue but had to do with migrants as well. Majority of migrant farmers also owned less than 6 acres of farmland. This confirms Damnyag et al. (2012) who found that, migrant farmers in Ghana's high forest zones were cultivating on small parcels of farmland due to high cost of renting farmland and discrimination by native farmers. This situation could largely limit farmers' productive capacity since they do not have access to

large parcels of land for farming. This is likely to have some food security and household income implications on the farmers which could exacerbate their vulnerability to the impacts of climate change since agriculture serves as the main means of livelihood for them. This is so in that, when farmers have limited resources like land, they are more likely to be limited in their capacity to increase production in order to adequately take care of their household food and income needs. Therefore, this situation could further impoverish them, thereby limiting their adaptive capacity to climatic shocks. Apart from that, farmers' ability to effectively adapt to the impacts of climate variability and change is largely dependent on access to basic resources like land that can enable them to respond effectively to evolving climate shocks. For instance Jones et al. (2010) opined that a system's adaptive capacity is largely dependent on availability and access to key assets, that allow that system to effectively respond to emerging climatic shocks and opportunities, and to be able to adopt innovations in response to those changes. The relatively small sizes of farmland among most of the farmers could also limit their ability to use parts of their farmlands as collateral in order to access financial credit that could enable them to expand their production scale and to invest in modern agricultural technologies for increased productivity. Moreover, the inequality that exists between male and female with regards to the size of farmland is largely blamed on the existence of male centred kinship institutions that discriminate against women from acquiring land. It is largely acknowledged that women contribute over 50% of the food needs in Sub-Saharan Africa (FAO, 2011). Therefore, given this situation where women are not given a fair share of their land needs, it is mostly likely that women's contribution to food production in the district would be adversely affected.

5.1.2 Mode of Land Acquisition

It was reported in the study that about 50.6% of the farmers borrow land from their relatives for farming. Most of those who acquired their farmlands through this arrangement were

largely the female and migrant farmers. However, about 71.9% of male farmers acquired their farmlands through inheritance. Indeed, this concurs with the findings of Tsikata and Yaro (2014) who found in the Northern Region of Ghana, that women only rely on their relatives who grant them access to land for farming purposes whereas their male counterparts largely acquired their farmlands through inheritance. It is also in line with Udry (2011) who found that land inheritance was only patrilineal in the three regions of Northern Ghana which limited women from inheriting land. This situation is largely due to cultural norms which restrict women from inheriting land in most parts of northern Ghana where this study was conducted (Alfred & Bonye, 2012). The implication of this is that, most of the farmers especially the women were not likely to be tenure secure and could lose access to those lands as and when the owners need their lands. This situation may adversely influence the farmers' investment decision in improving the fertility of their farmlands and the adoption of certain adaptation strategies since they may not have access to the lands for longer periods. When farmers do not have secure rights on the lands that they cultivate, they are likely not to have emotional attachment to such land and therefore do not invest in improving the productive capacity of the land. This situation can lead to low crop productivity, low farm income and household food insecurity among most of the farmers which may further limit their adaptive capacity to the impacts of climate variability and change.

5.1.3 Types of Land Rights

With respect to rights that farmers had to their farmlands, it was found that a little over half (54.7%) of the farmers had only user rights to their lands. Indeed, this situation has the tendency to limit the adaptive capacity of majority of the farmers. This is so in that, user rights do not give farmers control over the land and may limit their ability to invest in efficient adaptation technologies that can enable them to increase productivity and to

improve their living standards. It is generally perceived that male farmers mostly have favorable land rights than their female counterparts (Ahmed et al., 2016; Tsikata and Yaro, 2014). This analogy is confirmed by the findings of this study which shows that about 97.9% of female crop farmers had only user rights to their farmlands compared to 70.8% of male crop farmers who had transfer (complete) rights to their farmlands. Transfer rights guarantee tenure security than that of user and control rights (Galiani and Schargrodsky, 2010). Having largely user rights implies that most of the farmers especially women had limitations with regards to the use of their farmlands. This could affect the asset base of the farmers and even create more inequality in land allocation which could exacerbate their vulnerability to climate variability and change (Jones et al., 2010).

5.1.4 Levels of Land Decision Making

Indeed, in order to enhance the adaptive capacity of farmers, the issue of institutions and entitlements as outlined in the conceptual framework of this study becomes very important. There must exist dynamic and appropriate institutions that allows for fairness and access to vital assets and resources (Jones et al., 2010; Revi et al., 2014). The study found that decision making with respect to land allocation or distribution are largely reserved for family heads and in some instance clan heads which follows a rigid system of land governance that is largely hinged on traditions and the belief system of various clans and families. This affirms the assertion of Awumbila and Tsikata (2010) that, tenure arrangements in most parts of Ghana are based on customary norms which are mediated by male centred kinship institutions at the family or community levels. Given that women are mostly restricted by customary norms regarding their participation in land decision making, women's suggestions and demand for fertile and bigger sizes of farmlands could be ignored since these institutions do not provide any fair support for them when it comes to land acquisition. The overall implications of this phenomenon could be low scale of production,

low productivity, household food insufficiency, low household income and above all, poverty especially among the women farmers. These conditions could further limit their adaptive capacity and hence the effects will continue in a cascading manner.

5.2 Perceived Level of Farmland Tenure Security

Jones et al. (2010), argued that when farmers perceive their land tenure security to be maximum it empowers them to undertake flexible decisions with respect to the innovations or adaptation strategies that they could possibly employ in order to maximize production and to effectively adapt to the impacts of climate variability and change.

In ascertaining the general perception of the surveyed farmers about the level of their farmland tenure security, less than half of the farmers perceived they had maximum level of tenure security. Most men were perceived to have maximum tenure security than women. This implies that majority of the farmers were less likely to be able to take flexible plans that could enable them effectively adapt to the impacts of climate change. Contrary to Quansah (2012) who found in the Cape Coast Municipality that most women had maximum land tenure security and documented titles to their lands, this study found that, majority of women farmers had either no tenure security or minimum tenure security. However, this finding resonates with Antwi-Agyei et al. (2015) who found in the Bongo District and the Ejura Sekyedumase Municipality that male farmers were tenure secure than female farmers and that of Ahmed et al. (2016) who also found in the Lawra and Jirapa Districts of the Upper West Region that there was inadequate land tenure security among women farmers in the districts. On the part of other farmer groups such as natives and migrants, perceived level of land tenure security did not vary among them. This contradicts with Kidido et al. (2017) who found in the Techiman traditional area that, migrant farmers were tenure insecure compared to native farmers. However, more native female farmers reported of being tenure secure than the migrant female farmers. This could be due to the fact that

women generally find it difficult in accessing land for farming and as a result being a migrant woman could have further made it difficult for the migrant female farmers to enjoy secure land tenure rights in the surveyed communities. The findings of this study thus implies that most of the farmers' adaptive capacity to climate variability and change is limited especially the women since more female farmers than their male counterparts have inadequate tenure security over their farmlands (Bawakyillenuo et al., 2016). This situation is largely accounted for by the predominant male centred kinship institutions and system of entitlements which tend to create gender inequity with respect to access to and tenure security over land in favour of the male farmers (Tsikata and Yaro, 2014; Awumbila and Tsikata, 2010).

5.3 Determinants of Farmland Tenure Security

Farmland tenure security is defined as the perceived probability or likelihood of a farmer not losing his/her access to and control over parts or whole of his/her farmland to any person of party without his/her own consent (Alemu, 1999).

Farmland tenure security was reported to be high among only 41.1% of the farmers surveyed. Results of the binary logistic regression showed that, the main determinants of farmland tenure security were; age, sex (gender), and type of land tenure rights. Thus, farmers who were aged, male and those who hand transfer rights to their farmlands were tenure secure than the rest of the farmers. This is consistent with the findings of Ayamga et al. (2015) who found in four agro-ecological zones of Ghana that farmland tenure security was significantly influenced by age of farmers and type of land tenure rights including other socio-economic variables. Indeed, these findings could largely be due to social-cultural norms that give power to male and the aged at the neglect of women and youthful farmers (Kameri-Mbote, 2013). In most parts of Ghana, aged farmers mostly participate in land decision making at both the family and community levels. This therefore improves their

tenure security than the youth who are mostly not involved when it comes to land decision making. Similarly having transfer rights to land gives farmers' complete control over the use of such lands and therefore farmers land rights are largely protected by the traditional land administrative authorities. This suggest that aged farmers and those with transfer land rights are in a better position to plan ahead when it comes to adopting innovation or efficient adaptation strategies for adaptation compared to the youth and those who do not have transfer (complete) land rights. Based on this scenario, it is mostly likely that the adaptive capacity of women and youth farmers as well as those without transfer land rights would be largely limited. This is so in that, Jones et al (2010) argued that when there are no fair entitlements to productive resources like land among farmers; it affects their ability to take flexible decisions on how to invest in the adoption of efficient adaptation strategies. Given that women contribute over 50% of their household food needs (FAO, 2010), household food security could be adversely affected since women do not have security over their farmlands, their ability to invest in efficient production technologies will be limited and that can further limit their adaptive capacity to climate variability and change. Similarly given that the youth are the most energetic ones and innovative friendly than the aged, productivity could be affected since the youth are less likely to be tenure secure, their lack emotional attachment to the land they cultivate and therefore may not invest in improving productivity with respect to such lands.

5.4 Influence of Land Tenure Rights on Choice of Adaptation Practices

This section discusses key findings on the influence of land tenure rights on farmers' choice of on-farm adaptation strategies that were reported as common adaptation practices in the district.

5.4.1 Use of Early Maturing Crop Varieties

Results of a binary logistic regression indicated that household size of the farmers and access to agricultural extension services were statistically significant determinants of the use of early maturing crop varieties as adaptation strategy by the surveyed farmers. Famers who had larger household sizes including access to agricultural extension services were more likely to adopt early maturing crop varieties for adaptation. Interestingly, land tenure rights did not significantly influence farmers' decisions in the choice of this strategy. This concurs with Antwi-Agyei et al. (2014) who discovered in the Sudan Savanna and Forest Savanna transition zones of Ghana that, farmers access to agricultural extension services including their household sizes and other socio-economic variables significantly influenced the choice of various adaptation strategies including the adoption of early maturing crop varieties. Similarly, Armah et al. (2013) found in the Northern Region of Ghana that farmers' household sizes significantly influenced their choice of adaptation strategies such as the use of early maturing crop varieties and others. Lager household size usually encourages information and knowledge sharing among members at the family levels which facilitates the adoption of modern and improved crop varieties such as early maturing crop varieties (Jones et al., 2010). Also, access to agricultural extension services promotes education among farmers on climate change and the available adaptation techniques that could be adopted in order to increase productivity. Extension agents promote farmers knowledge on climate change and provide them with the necessary skills that they need for adaptation. Therefore farmers who have access to agricultural extension are more exposed to better adaptation options than those who lack access to extension services.

5.4.2 Shifting of Planting Dates

The location of farmers was the main determinant of the shifting of planting dates as an adaptation strategy. It emerged that, farmers from Pavuu were less likely to shift their

planting dates in response to changes in climatic variables like rainfall. This corroborates with Bawakyillenuo et al. (2016) who found in the rural savanna areas of Ghana that farmer's choice of adaptation strategies such as shifting of plating dates were significantly influenced by the location (village) of the farmers. Farmers at different locations have different access to information and experiences when it comes to choosing appropriate adaptation interventions. Most farmers at Pavuu had little access to agricultural extension services and were much glued to their traditional beliefs with little adoption of new technologies or innovation. When farmers fail to adjust their planting dates within the reliable or stable rainfall period they could experience dry spells which may affect crop productivity and farm income (Ndamani & Watanabe, 2015). This could lead to food insufficiency and poverty which could limit their adaptive capacity.

5.4.3 Use of Irrigation

Irrigation is widely acknowledged as one of the most preferred adaptation strategies among farmers in semi-arid regions (Bawakyillenuo et al., 2014). Based on results of a binary logistic regression model, location of the farmers was found to be very significant in determining the use of irrigation as an adaptation strategy by the farmers. It was found that farmers from Pavuu were less likely to adopt irrigation as an adaptation strategy compared to those from Tolibri, Kalsagre and Brewong. This is in line with Bawakyillenuo et al. (2016) who found in rural savanna that, adoption of irrigation as an adaptation strategy was significantly determined by the location of the surveyed farmers. In the high rate of adoption of irrigation by farmers from Tolibri and Brewong is due to their relative locations which are somehow closer to the Black Volta. This has created the opportunity for many of the farmers from these locations to use water from the river for irrigation purposes. The low level of adoption of irrigation by farmers at Pavuu could be attributed to its geographical location which is far from the Black Volta. Apart from that, Pavuu has serious water

challenges for both drinking and farming purposes due to the existence of only one borehole which is located far from the community. Indeed, this situation further undermines the adaptive capacity of farmers in Pavuu compared to the rest of the communities that were surveyed. Jones et al. (2010) opined that when there is improved access to resources and technology that allow farmers to respond to evolving or changing climatic circumstances it leads to improvement in their adaptive capacity.

5.4.4 Adoption of Zai Farming Technique

Zai farming technique is a traditional soil nutrient and water conservation strategy usually made up of small pits measured 20-30cm in width and 10-20cm deep and spaced 60-80cm (Lahmar et al., 2012). Seeds are sown into the pits after filling them with one to three handful of organic manure (Kagambega et al., 2011). The pits serve to collect and concentrate both nutrients and water at the plant and therefore reduce water stress especially in areas of low and erratic rainfall (Amaru and Chhetri, 2013). The binary logistic regression model shows that farmers' location, gender (sex) and size of farmland were the very significant determinants of adoption of zai farming technique for adaptation. This is in line with Lahmar, Bationo, Lamso, Guéro, and Tittonell (2012), who found size of farmland as a significant determinant of adoption of the zai farming technique among farmers in Burkina Faso. If all other factors are controlled, famers from Pavuu were more likely to adopt zai farming technique for adaptation compared to farmers in the rest of the surveyed communities.

Pavuu is relatively located on a high land therefore, majority of the farmers use the zai pits system in order to retain water and nutrients on their lands since the water could easily run down the slopes. The use of this technique by most of the farmers from Pavuu could help improve soil moisture and nutrients for increase crop productivity. For instance, Amede, Awulachew, Matti, and Yitayew (2014), opined that, the use of the zai farming technique

helps farmers to be able to collect about 25% of run-off coming from about five times its area. Also, female farmers were less likely to practice zai farming for adaptation compared to male farmers. This could be due to the fact that, the digging of the zai pits is labour intensive and requires more energy which limited most of the female crop farmers from adopting it as part of their adaptation strategies. With respect to the size of farmland, farmers who owned more acres of farmland were less likely to use zai farming technique as part of their adaptation strategies. This is contrary to the assertion of Jones et al. (2010) that, when farmers have access to more productive inputs like land, they are always better able to take advantage of new technologies or innovation for adaptation which can lead to increase in both farm output and farm income that can translate into enhancing adaptive capacity. The low adoption of the zai technique among farmers who had bigger farm size could also be attributed to the difficulty in digging the zai pits. For instance Kaboré and Reij (2004), argued that it takes about 450 hours to dig 20000-25000 pits per hectare which discourages most farmers from adopting the practice.

5.4.5 Use of Agroforestry

Agroforestry is noted to be one of the most efficient strategies for adaptation to the impacts of climate variability and change especially in semi-arid regions (Antwi-Agyei et al., 2014). Contrary to other findings (see Ahmed et al., 2016; Damnyag et al., 2012), land tenure rights, farm size, perception of climate change, household size, access to agricultural extension and ancestry of the farmers had no any statistically significant influence on adoption of agroforestry for adaptation. Variables that significantly influenced farmers' adoption of agroforestry for adaptation were the location and sex of the farmers. Again, it was found that farmers from Pavuu as well as female farmers were less likely to adopt agroforestry for adaptation if other factors are controlled. The variations in the adoption of agroforestry for adaptation could be attributed to the belief system of most of the famers,

the micro climatic conditions of the various locations and resource constraints. For instance, Deressa et al. (2009) and Jones et al. (2010) opined that, availability and access to capital resources; physical, financial, natural human and social capital influences farmers adaptive activities to the impacts of climate variability and change. Women were also less likely to adopt agroforestry for adaptation because they had limited access to land and in most instances they cultivate on just smaller plots of land. Apart from that most of the women only had user rights to their farmlands and were mostly given access to their farmlands on seasonal basis which limited their capacity to undertake long term strategies like agroforestry.

5.4.6 Use of Crop Rotation

Results of a binary logistic regression model showed that ancestry, farm size and land tenure rights were significant determinants of adoption of crop rotation for adaptation among the surveyed crop farmers. This is in line with Nyadzi et al. (2016) who found that, land size and tenure rights had significant influence on farmers' choice of adaptation practices. Similarly, Ahmed et al. (2016) also found that the adoption of adaptation strategies including crop rotation was significantly influenced by farm size, and tenure rights among farmers in the Lawra and Jirapa Districts. If all other factors were controlled, migrant farmers were likely to adopt crop rotation for adaptation compared to native farmers. This may be due to the experiences of the migrant farmers which shape their knowledge and ability to implement innovative measures that can increase productivity and enhance their adaptive capacity. Similarly, farmers who had transfer rights to their farmlands were more likely to practice crop rotation for adaptation compared to farmers who had only user rights to their farmlands. Transfer land rights gives farmers control and complete rights to their farmlands. Therefore they are better able to undertake agronomic practices that can improve the fertility of their farmlands by alternating different types of

crops such as legumes and cereals or roots and tubers on their farmlands. However, farmers who owned more than 10 acres of farmland were less likely to adopt crop rotation as an adaptation strategy compared to those who owned below 6 acres of farmland. This implies that since they have access to larger plots of farmlands they would prefer to choose long term strategies such as land rotation or bush fallowing where they allow some of their farm plots to lie idle for some years for them to regain their fertility.

5.5 Implications of the Findings on Crop Farmers' Adaptive Capacity

The results clearly indicates that the adaptive capacity of majority of the farmers, especially female and migrant farmers, could adversely be affected due to the tenure arrangements which limited their access to and control over land as a productive resource. This is in line with Antwi-Agyei et al (2015) who found in the Bongo District and Ejura Sekyedumase Municipality that women and migrant farmers were limited in their ability to adapt to the impacts of climate change due to tenure insecurity. Majority of the farmers within these groups especially women had only user rights, smaller land sizes and insecure tenure rights over their farmlands, which implies that their ability to take flexible plans that could enable them to effectively and efficiently adapt to the impacts of climate variability and change was limited. For instance Jones et al. (2010) and (N. C. Johnson et al. (2010)) opined that secure access to productive assets like land, leads to the enhancement of farmers' ability to effectively adapt to climate change by adopting new adaptation technologies that may lead to increase in productivity. However, tenure rights had negative consequences on the farmers' annual farm income levels particularly the female farmers and this situation could further limit their ability to access credit to support their farming activities. Though land tenure rights significantly influenced farmers adoption of a few of the adaptation strategies, it implies that, land tenure rights have cascading effects on other socio-economic variables of the farmers which could further affect their adaptive capacity.

5.6 Summary

This chapter discussed the key results of the study which included the forms of land tenure arrangements, perceived level of farmland tenure security, determinants of farmland tenure security and the influence of land tenure rights on the choice of on-farm adaptation strategies. It finally gave an overview of the implications of the key results on the adaptive capacity of the respondents in relation to the conceptual framework of the study. The findings of the study generally showed that majority of the farmers especially women had insecure tenure arrangements. Therefore perceived level of farmland tenure security was found to be at a minimum level. This could limit the productive capacity of the farmers and further worsen their adaptive capacity to evolving climatic shocks. Major determinants of farmland tenure security among crop farmers were sex (gender), age and types of land rights. This may be due to the traditional norms that govern land allocation and use in the study area. Moreover, land tenure rights had significant influence on farmers' choice of some of the adaptation strategies but had no any significant influence on the use of short term adaptation strategies. The next chapter presents a summary of the findings, conclusion and recommendations with respect to the study findings.

CHAPTER SIX

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

6.0 Introduction

The main objective of this study was to examine the implications of land tenure rights on crop farmers' adaptive capacity to climate variability and change. This chapter presents a summary of the major findings of the study and draws a conclusion based on those findings. It also presents recommendations with respect to the findings of the study.

6.1 Summary of Findings

The findings are presented based on the specific objectives of the study which include; forms of land tenure arrangements, perceived level of farmland tenure security, determinants of farmland tenure security and the influence of land tenure rights on choice of on-farm adaptation strategies among crop farmers.

The study found that, majority of the farmers especially, women were cultivating on smaller land parcels. This situation affected the annual farm income of female farmers compared to the male farmers. The common means of land acquisition was through inheritance, gift, leasehold and borrowing. However, majority of the farmers' particularly female farmers only acquired their farmlands through family grant due to socio-cultural norms which restricted them from inheriting the land. Rights to land holding were largely in the form of user rights but this again was very high among female farmers than male farmers with land decision making under the authority of family and clan heads. The results also showed that aged farmers had bigger land size and transfer (complete) rights than the youth farmers but statistically the difference was not significant. This was similar in the case of native and migrant farmers.

Perceived level of farmland tenure security was reported as minimum among majority of the farmers. This was high among female farmers than male farmers. Most of those reported of having maximum level of tenure security were male farmers. Perceived level of farmland tenure security did not vary significantly between aged and youth farmers as well as between native and migrant farmers. The data was further disaggregated between native female farmers and migrant female farmers in order to determine if there was a significant difference with respect to their perceived level of tenure security but the chi square test proved that there was no any significant difference between the native female and migrant female farmers with respect to their perceived level of farmland tenure security.

The socio-economic variables that significantly determined farmland tenure security among the surveyed farmers was mainly; age, sex (gender), and type of land tenure rights. If other factors were controlled, the probability of male farmers being farmland tenure secure was higher than female. Apart from this, the probability of aged farmers being farmland tenure secure was also higher than the youth farmers whilst the probability of farmers who had only user rights to their farmlands being tenure secure was lower than those who had transfer rights. Other socio-economic variables such as educational level, ancestry, household size, the size of farmland and distance to farmland were statistically not significant determinants of farmland tenure security. However, these variables together with the significant variables (gender, age, and types of land rights) explained about 78.7% of the variation in the probability of the crop farmers being tenure secure.

The influence of land tenure rights on farmers' choice of adaptation strategies was found to be statistically significant in the case of the adoption of adaptation measures such as; crop rotation and zai farming. Other adaptation strategies such as; the use early maturing crop varieties, shifting of planting dates, irrigation and agroforestry were not significantly influenced by land tenure rights and arrangements. Other variables such as gender, location

(village) of the farmers, access to agricultural extension services and household size also had a significant influence on farmers' adaptation decisions.

6.2 Conclusion

Based on the findings of the study, it is concluded that land tenure rights poses a serious challenge to climate change adaptation among many farmers in the Lawra District, given the inequality that exist with respect to access and tenure security over land for agriculture production in the surveyed communities. This phenomenon has the potential to reduce majority of the farmers' emotional attachment to the lands that they cultivate their crops which could reduce investment in crop production in the district in terms of the use of efficient and improved technologies or adaptation options. More to that, the land tenure arrangements coupled with the high level of tenure insecurity among majority of the farmers especially the women, further limits their ability to use their lands as collateral in order to access more financial credit that may help them to expand production. The consequences of this are numerous ranging from; the low scale of production, low productivity, household food insufficiency, low household income and above all, household poverty which could have cascading effects on the farmers' adaptive capacity.

6.3 Recommendations

Based on the findings of the study, the following recommendations are made;

The Ministry of Gender and Social Protection together with the Lands Commission Department should put in place a community sensitization programme that could help to provide more education on women's land rights and the need to improve access to land and tenure security among women in the area. The media should also play a supporting role in this, through the promotion of community radio talk-shows in order to facilitate the sensitization process.

It is also recommended for the establishment of a strong women movement at the community levels to give women a strong voice that can enable them to advocate for better deals in land governance at the local community level since they were more limited in accessing land than the rest of the farmer groups. Civil Society Organizations such as CARE International, SEND-Ghana, and others including the Ministry of Gender and Social Protection should undertake projects that will support the formation of such women networks in order to empower them to negotiate for better land deals.

Climate change adaptation policy makers, especially in relation to the agricultural sector, should also design community based adaptation policies and projects that target improving access to land and tenure security among all social groups of farmers.

The results also showed that there are other socio-economic factors that influence farmers' choice of adaptation practices either than land. Therefore, it is recommended that more social infrastructure such as irrigation schemes and the improvement of farmers' access to more agricultural extension services is needed in the study area. Educating the farmers on agricultural intensification will be the best option since majority of them had only smaller acres of farmland. These should be done by MOFA and the Lawra District Assembly as well as NGOs that are into food security and climate change adaption.

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APPENDICES

Appendix 1: Survey Questionnaire

Implications of land tenure rights on farmers' adaptive capacity to climate change in semi-arid north-western Ghana: the case of crop farmers in the Lawra District.

This study is being conducted to examine the implications of land tenure rights on the adaptive capacity of crop farmers to the impacts of climate change in the Lawra District. The study forms part of the requirements for the award of an MPhil degree in Climate Change and Sustainable Development, University of Ghana, Legon. The information you shall provide is only for academic purposes and will be treated strictly as confidential.

Socio-economic and demographic Characteristics of Respondent

1. Name of village/area……..
2. Sex [1] Male [2] Female
3. Age ……..
4. Marital status [1] Married [2] Single [3] Divorced [4] Widowed
5. Religion: …….
6. Level of formal education [1] None [2] Primary school [3] JHS/Middle school [4] Secondary/Technical school [5] Tertiary school
7. Ancestry **[**1] Native [2] Migrant (settler)
8. Household size [1] 1-6 persons [2] 7-12 persons [3] Above 13 persons
9. Size of farmland (in acres) ……
10. Annual farm income (Gh₵)……
11. Major crops cultivated ……
12. Distance to farmland (Km) ……

13. Do you have access to agricultural extension service and training? [1] Yes [2] No

Common Forms of Land Tenure Rights

14. How did you acquire your farmland? [1] Purchased [2] Inherited [3] Gift [4] Sharecropping [5] leasehold [6] Renting [7] Family grant
15. What rights do you have over your farmland? [1] User rights [2] Transfer rights [3] Control rights
16. How is land distribution in your community decided? [1] On clan basis [2] On family basis [3] According to social status [4] other, specify……..

Perceived level of land tenure security among farmer

Please kindly tick [1] Yes or [2] No to answer the following questions;

17. Will you lose your farmland if you leave it to fallow for at least 5 years? **[**1] Yes [2] No
18. Are you legally recognized by the leaders of your community as the right holder of your farmland? **[**1] Yes [2] No
19. Is your farmland safe from encroachment? **[**1] Yes [2] No
20. Can you use your farmland as collateral to access financial credit for farming without restriction by any person? **[**1] Yes [2] No
21. Do you perceive any land conflict in the near future with respect to your farmland? **[**1] Yes [2] No
22. Are you satisfied with the arrangements through which you acquired your farmland? **[**1] Yes [2] No
23. Based on your answers to Q21-Q27 which of the following is best applicable to you with respect to the status of your land tenure security? [1] No security [2] Minimum security [3] Moderate security [4] Maximum security

Influence of Land Tenure Rights on Choice of Adaptation Practices

24. Have you noticed any change in the climate comparing the 1980s/1990s with the recent past 10 years or more? [1] Yes [2] No
25. Comparing the 1980s/1990s with the recent past 10 years or more, have you observed any change in the rainfall pattern? [1] Yes [2] No
26. Kindly specify the trend of the change if yes; [1] Increasing [2] Decreasing
27. Comparing the 1980s/1990s with the recent past 10 years or more, have you observed any change in the temperature? [1] Yes [2] No
28. Kindly specify the trend of the change if yes; [1] Increasing [2] Decreasing
29. As a crop farmer have you undertaken some adaptation strategies in order to reduce the impacts that climate variability and change have on your production? [1] Yes [2] No
30. If yes, please kindly mention the various strategies that you use for adaptation

    ……

    ……

Thank you!

Appendix 2: Focus Group Discussion Guide

Implications of land tenure rights on farmers' adaptive capacity to climate variability and change in semi-arid north-western Ghana: the case of crop farmers in the Lawra District.

1. How do you acquire farmland in this community
2. What rights do have to your land?
3. What challenges do you face in acquiring land for farming?
4. Who are mostly marginalized in acquiring farmlands in this community?
5. How will you describe the level of tenure security associated with your farmland?
6. Do you foresee losing your farmland in the next 3-6 years? If yes why?
7. What are some of the climate change adaptation practices among farmers in this community?
8. How do land tenure rights influence the choice of those adaptation practices?

Appendix 3: Key Informant Interview Guides

Implications of land tenure rights on farmers' adaptive capacity to climate change in semi-arid north-western Ghana: the case of crop farmers in the Lawra District.

Guide for Traditional Leaders

1. What are the common ways of acquiring land in this community? ……

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2. Are there some crop farmers who are not allowed to own land in this community? [1] Yes [2] No
3. If yes, which group of crop farmers? ……
4. Do individual farmers have absolute control over the lands they cultivate? [1] Yes [2] No
5. If no, why? ……
6. How will you describe the level of tenure security among various crop farmers in this community? ……
7. Is there any system in this community to protect people from losing their farmlands? [1] Yes [2] No
8. If yes, what is it.....?
9. Are there cases of land conflicts in this community? [1] Yes [2] No
10. If yes, who is/are usually vulnerable to these conflicts? …….

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In your opinion as a traditional leader, what do you think are the things that can bring about land tenure security among crop farmers in this community? Please mention as many as possible.……

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Guide for Extension Officers

1. Are there land related challenges faced by crop farmers in this district? [1] Yes [2] No
2. If yes, what are those challenges? ……..
3. Which groups of the farmers mostly face these challenges? ……
4. What are some of the climate change adaptation practices among crop farmers in this community? Please mention them…….

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   ……...
5. Are crop farmers in this district well aware of these practices? [1] Yes [2] No
6. If no, why? ……
7. Do you think land tenure rights influence the decision of crop farmers regarding the choice of some of the adaptation practices? [1] Yes [2] No
8. If yes, what kind of land tenure rights/arrangements promotes farmers' interest in choosing more efficient adaptation practices?
9. Generally how will you describe the implications of land tenure rights on farmers' ability to adapt to the impacts of climate change in this community?

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