INFLUENCE OF SMALL HOLDER FARMERS ON HOUSEHOLD FOOD SECURITY IN AGRO-PASTORAL ZONES IN WEST POKOT COUNTY, KENYA

BY

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DECLARATION

Declaration by Candidate

I hereby declare that this thesis is my original work and that it has not been presented for award of any degree, published or submitted for examination in this or any other university. No part of this work can be reproduced without prior permission from the author and/or Moi University.

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DEDICATION

I dedicate this work to my family; Alfred, Monica, Kelly, Sam, Alazne, Adrianna and Alexie for your prayers and sacrifice during the period of my studies.

May the good Lord bless you.

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ABSTRACT

Despite their importance in global and regional food production, smallholder farmers' especially in agro-pastoral regions have received minimal recognition in policy, strategic frameworks and interventions. In Kenya, there has been little focus by government and interventions on agriculture for smallholder farmers in agro-pastoral regions, thus, rendering them into numerous vulnerabilities and constraints that impede their agricultural activities. This study broadly looked at the influence of smallholder farmers on household food security in agro-pastoral zones in West Pokot County, Kenya. The objectives of the study were to; examine the role of smallholder farmers' socio-economic factors on household food security, to evaluate smallholder farming characteristics on household food security, to examine the role of smallholder farmers' household labour conditions on household food security and to determine the influence of climate variability on smallholder farmers activities towards achieving household food security in West Pokot County. This study adopted convergent research design guided by the entitlement theory, farming systems approach and basic needs theory. This study adopted pragmatism as its research paradigm and employed mixed methods approach. The target population comprised of 78,946 smallholder households in West Pokot County. Multi stage and systematic random sampling techniques were used to determine a sample size of 297 respondents. Instruments for data collection were; questionnaires, interview schedules and observation schedules. Correlation coefficient and coefficient of determination were used to determine the relationships between the variables. The linear regression results indicated that there was a statistically significant positive relationship between household food security and socio-economic factors (β=.699, p=.000). The results also implied that a unit increase in household labor conditions would result to significant increase in household food security (β=.670, p=.000). A moderated multiple regression (MMR) was also carried out to assess the moderating effect of farmer associations on the four variables. The study showed that farmer associations have significant moderating effect on the relationship between smallholder farming characteristics and household food security (β=0.569, p=0.000).The F-statistic was significant at $p<0.001$ ($F=24.169$) which implied that there existed a statistical relationship between the interaction (predictor) and household food security (criterion) variables, either directly or indirectly. From the study findings, it was concluded that the engagement of smallholder farmers to farmer associations would greatly enhance food security in agro-pastoral zones. This study recommends the involvement of various stakeholders in food security such as NGOs, National and County governments for policy formulation and capacity building on smallholder farmers associations to enhance food security.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

OPERATIONALIZATION OF TERMS

Agro-Pastoral Zones: This describes areas where apart from livestock farming, some crop cultivation is also practised.

Climate variability: Are the variations in the mean state and other statistics (such as standard deviation and the occurrence of extremes) of the climate on all temporal and spatial scales beyond that of individual weather events.

Farmer Association: A local organization of farmers who have banded together to take advantage of social and economic benefits.

Farming characteristics: These are factors that determine food production at farm level such as farm size under cultivation, type of food crops on farm, farming practises and preservation of farm produce.

Food Access: Individuals have adequate incomes or other resources to purchase or barter to obtain levels of appropriate foods needed to maintain consumption of an adequate diet/nutrition level.

Food availability: The overall ability of the agricultural system to meet household food demand adequately.

Food security: This is when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

Food stability: Refers ability to access and utilize appropriate levels of nutritious food over time

Food utilization: Refers to the actual food that is consumed by individuals; how it is stored, prepared, and consumed; and what nutritional benefits the individual derives from consumption

Household Head: This refers to an adult individual (male or female) held responsible for the general organization and running of the household

Labour Conditions: These are the conditions that determine availability of labour for participation in food production.

Smallholder farmer: Refers to a farmer who cultivates small farms dependent mostly on family labour.

Smallholder farming: It refers to farming whereby there are small farms that rely mainly on family labour. It is the backbone of agricultural production in developing countries

Socio-economic factors: In this study, it refers factors that influence farming at household level such as income, ownership of asset, education, knowledge and skill in agricultural production.

ABBREVIATIONS AND ACRONYMS

ASAL	Arid and Semi-Arid Land
CIDP	County Integrated Development Plan
CoK	Constitution of Kenya
DEFRA	Department for Environment, Food and Rural Affairs
FAO	Food and Agricultural Organization
FSOM	Food Security Outcome Monitoring
GAM	General Acute Malnutrition
GAMP	Global Acute Malnutrition Prevalence
GHI	Global Hunger Index
GIS	Geo-Spatial Information Systems
IEK	Indigenous Ecological Knowledge
IUNC	International Unit for Conservation of Nature
KNSB	Kenya National Bureau of Statistics
NFNSP	National Food and Nutrition Security Policy
NLP	National Land Policy
NSCA	National Sample Census in Agriculture
QUAL	Qualitative
QUAN	Quantitative
RC	Response Code
SDGs	Sustainable Development Goals
SSA	Sub-Saharan Africa
UN	United Nations
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter presents the background to the study, the statement of the problem, objectives of the study, significance of the study, assumptions of the study and finally the scope of the study that essentially lays the foundation for the study.

1.1 Background of the Study

Globally, one of the main challenges is how to ensure food and nutrition security for a growing population whilst adjusting to an overall net increase of disasters, including those caused by climate change, and increased economic volatility, and ensuring long-term sustainable development (FAO, 2012). For food security to exist at the national, regional, and local levels, food must be available, accessible, and properly utilized. Availability of food means that enough safe and nutritious food is either domestically produced or imported from the market. However, food availability does not ensure food accessibility. Government policies must also contribute to equal distribution of food within nations, regions, and communities. In addition, for food to be accessible, individuals and families must be able to afford the food prices on the market. Food must be properly utilized which depends on proper food storage to guard against spoilage, appropriate handling to avoid disease transmission, and proper preparation to ensure nutritiously balanced meals (FAO, 2007).

Studies done in the developed countries show that food security is an important agri-pastoral aspect. In the UK, the enhancement of food security is a serious issue to the extent that the government uses a robust policy to enhance capacities for both large scale and smallholder farmers to produce more (Gill, Feliciano, MacDiarmid, & Smith,

2020). In the USA, studies have shown that small holder farmers play a pivotal role in enhancing household food security but from a review of these studies, it is the large scale farmer who receives significant attention due to the economies of scale that their farming production commands (Gill *et al*., 2020). Smallholder farmers are however instrumental in the agro-pastoral zone development in India and China. In these two countries, largely owing to their history, smallholder farmers largely determine the nature, scope and production efficiency of their livestock and crops. In India, for instance, smallholder farmers account for 86% of the total number of farmers and contribute to 57% of the crop production (Bisht, 2019). In China, Reports show that as at 2019, smallholder farmers accounted for 79% of the total farmer population but only contributed 38% of the total agro-pastoral production (Bisht, 2019). This shows a significant disparity between the smallholder farmer population and the agro=pastoral production in China.

The case in Africa is no different with Ghana and Nigeria showing an 85% and 87.1% average rate of population of smallholder farmers respectively who contribute to the agro-pastoral zone production at 47% and 44% respectively (Oladeebo & Masuku, 2019). This disparity has been attributed to concerted government efforts that promote large scale farming more that smallholder farming, often to the detriment of food security in those countries (Oladeebo & Masuku, 2019). Uganda also has similar challenges, with 2018-2019 results showing a significant mass of smallholder farmers who unfortunately produce less within the national food basket (Mapiye *et al*., 2019).

Food Security and development are now familiar concepts to a majority of researchers throughout the world, particularly among the developing countries, such as Kenya. Within the developing world, Africa, particularly Sub-Saharan Africa, is classified as

one of the poorest regions associated with escalating food security problems. As long as a society is deficient in all its food needs, poverty is inevitable, since food insecurity is viewed as both a cause and a consequence of poverty (Sanchez, Swaminathan, Dobie, & Yukshel, 2005). In order to adequately address development, it would be simpler to deal with food insecurity, as food is just one of the basic needs required by an individual for a minimum healthy life.

Sustainable Development Goal number 2, (SDG-2) aims to ‘‘end hunger, achieve food security and improve nutrition and promote sustainable agriculture’’. Intrinsically related to society, economy, and the environment, SDG-2 is key to the success of the entire SDG agenda (FAO, 2014). Although poor countries tend to show greater reliance on farming activities, food production and consumption is fundamental to any economy and permeates every society. Meeting SDG-2 is thus likely to invoke multiple synergies and trade-offs with other SDGs, across temporal and spatial scales, ultimately underscoring the indivisible nature of the SDG agenda (Gil, Reidsma, Giller, Todman, Whitmore & van Ittersum, 2018).

The eradication of hunger requires SDG-2 targets and indicators aligned with the four pillars of food security: availability (having available sufficient quantities of food, whose continued production also depends on a healthy environment), access (having the economic and physical means to obtain a nutritious diet), utilization (having adequate dietary intake and the ability to absorb and use nutrients in the body), and stability (ensuring the other three pillars on a consistent basis) (FAO, 2008). The triple burden of malnutrition—the coexistence of undernourishment, micronutrient deficiency, and over-nutrition manifest in overweight and obesity is thus a growing challenge all over the world (Gómeza, Barretta, Raney, Andersena, Meermane &

Thompsone, 2013) and indicates how structural changes affect the pillars of food security.

In the developed countries, the primary causes of food insecurity are majorly poverty, high illiteracy levels, poor health status, and certain disabilities that increase the risk of food insecurity for individuals and households for instance in the United States (FAO, 2014). In developing countries, the root causes of food insecurity include: poverty, war and civil conflict, corruption, national policies that do not promote equal access to food for all, environmental degradation, barriers to trade, insufficient agricultural development, population growth, high illiteracy levels, social and gender inequality, poor health status, cultural insensitivity, and natural disasters (FAO, 2012). All these factors contribute to either insufficient national food availability or insufficient access to food by households and individuals (IFPRI, 2002; FAO, 2011, 2012).

In Kenya, food insecurity is a monumental crisis affecting many, particularly in the rural areas and ASAL areas. According to the Global Hunger Index Report 2015 (GHI, 2015), Kenya was rated among 30 countries with the least food security index in the world. According to statistics from the Republic of Kenya (2016), only about a third of the Kenyan population can be said to be chronically food insecure. Official estimates indicate over 10 million people are food insecure with majority of them living on relief food. Over the last 3 decades, per capita food availability has declined by more than 10%. The International Food Policy Research Institute (I.F.P.R.I) classified the status of hunger in Kenya as alarming. It was indicated that negligible progress was made between 2000 and 2015 in terms of the global hunger index. Households are also seen to be incurring huge food bills due to the high food prices.

Food and Agriculture Organization (FAO) of the United Nations (2002), estimates that global food production needs to increase by 60% by 2050 where a vast majority of people will be affected by food insecurity live in developing countries. This challenge is further complicated by the paradoxical and contradictory fact that most of the chronically food insecure populations are smallholder farmers who have yet agriculture and food production as core business. This is mostly due to the fact that smallholder farmers buy more food than they sell as they are not able to grow enough foods to feed themselves adequately throughout the year, and as a result make up about three quarters of the world's hungry (Hawkes, Turner & Waage, 2012). This paradox has its roots in a number of challenges faced by smallholder farmers. The challenges include production constraints such as reliance on rain-fed crops and cultivation using unsuitable agricultural practices, lack of comprehensive land policy for smallholder farmers and low investments in farming making it difficult for smallholders to produce food sufficiently and efficiently. Other challenges include lack of postharvest processing technology, social constraints such as gender and environmental constraints such as climate change.

Nonetheless, despite all these challenges, the contribution of smallholder farmers to global food production is significant: they supply up to 50% of the worlds' cereal, 60% of the world's meat and 75% of the world's dairy production (Kremen, Iles & Bacon, 2012). Indeed, both urban and rural food consumers in developing countries count heavily on the efficiency of their local smallholder farmers to satisfy their food needs. Within this figure, smallholder farmers produce most of the food that is consumed locally (Campbell, Thornton, Zougmoré, Van Asten, & Lipper, 2014). Smallholders, as gross domestic food and nutrient providers have therefore a special role to play in the global efforts to improve food and nutrition security (Beddington, Asaduzzaman,

Fernandez & Scholes, 2012). Unfortunately, until recently small-scale farmers have not been the primary focus of agricultural development, and their actual and potential contribution to food and nutrition security is not valorised as it deserves (Grando, Pietromarchi, Desideri & Colombo, 2016).

Advocates of the right to food and food sovereignty attribute rising hunger to the promotion of big agro-industrial corporations and the international trade in food and its detrimental effects on local and national food production, especially on smallholder farmers. Improving productivity and intensifying crop production among smallholder farmers could be key to global food security and ending hunger. Smallholder farming systems are very diverse, and contribute considerably to global agricultural output of a variety of crops. Smallholders produce the bulk of food in developing countries, and in many instances their contribution is growing (Koohafkan, 2011). Smallholder farmers produce 70% of Africa's food supply (IA ASTD, 2009) and an estimated 80% of the food consumed in Asia and sub-Saharan Africa together (IFAD, 2011). According to Faber and Wenhold (2007), smallholder farmers usually address the nutrition needs of their households and can potentially impact human nutrition by providing a variety of foods in sufficient quantities to enable all household members to eat a diverse and nutritionally adequate diet (Oelofse, & Slabbert, 2007).

A majority of sub-Saharan Africa's population live in rural areas where poverty and deprivation are the most severe. Since almost all rural households depend directly or indirectly on agriculture, and given the sector's large contribution to the overall economy, it might seem obvious that agriculture should be a key sector in development (Grando*et al.*, 2016). However, while agriculture-led growth has played an important role in reducing poverty and transforming the economies of many Asian countries, the

strategy has not yet worked in Africa. Most African countries have failed to meet the requirements for a successful agricultural revolution, and productivity in African agriculture lags far behind the rest of the world (Hawkes *et al.*, 2012). This has recently led to renewed debate within the international development community concerning the role of agriculture, particularly small farms, in African development.

West Pokot County is one of the food deficient and food insecure Counties in Kenya (GOK, 2015). In agro-pastoral regions like West Pokot County in Kenya, smallholder farmers have negatively been affected by climate change and variability through its adverse impacts. Smallholder farmers in agro-pastoral rural areas have been experiencing low agricultural productivity, crop failure, human disease outbreak, pest and diseases, lack of water, shortages of agricultural-based food items at a household level and food insecurities (Mutekwa, 2007). These impacts have posed a huge threat to food security and livelihoods of most smallholder farmers compromising their well-being, as most of them depend on natural climatic sensitive resources such as agriculture for their livelihoods (Debela, Mohammed, Bridle, Corkrey, Mcneil, 2015).

In West Pokot County where this study was conducted, 80% of the population is dependent on small-scale agro-pastoral production systems as its main economic activity. Smallholder farmers are particularly vulnerable to climate variability and change, and the adoption rate of new climate-smart technologies is low.

The West Pokot CIDP, (2013-17) indicates that food poverty in the county stands at 69.7% which is an indicator that the county is faced with adverse challenges in ensuring food security. This also shows that majority of the population cannot afford the minimum basic nutritional support while farming methods have remained traditional over a long time. Just like in the rest of Africa, most rural households in the country

including West Pokot County earn their livelihood through small holder agriculture. Most of these smallholder farmers in Kenya contribute to an average of more than 80% of the agricultural labour force in Kenya (World Bank, 2010).Smallholding farming has multidimensional contribution to food security. These dimensions have been the subject of much speculation, but researches in this area are uneven and generally inconclusive. Most studies conducted on this issue have concentrated basically on the status of food security, ignoring the complex influence of smallholder farmers in agro-pastoral communities in West Pokot County.

The contribution of smallholder farmers to household food security can be examined through food availability, accessibility, utilization and stability. However, this can only be examined by studying the influence of smallholder farmers' socio-economic characteristics towards household food security. Other factors of interest are smallholder farming characteristics and household labour condition for smallholder farmers. It is evident; farming characteristics such as farming practices and type of food increases the availability and accessibility of food.

The premise of this study was to understand how smallholder farmers have influenced household food security basing through farmer associations on the above named characteristics which define the smallholder farmer in the society.

1.2 Statement of the Problem

West Pokot County is classified in the Crisis (Integrated Food Security Phase 3) due to low food security indicators such as food availability, food accessibility, food utilization and food stability (SMART Survey, 2017). The proportion of households with an acceptable diet had reduced from 82.3% in 2016 to 68.5% in 2017. The implication was that there was a reduction in food frequency, dietary diversity and

nutritive value at household level. There was an increase in the coping strategy index from 12.9 in 2016 to 18.6 in 2017 implying that more severe consumption-based coping strategies were being employed more frequently than in May 2016. The Global Acute Malnutrition Prevalence (GAMP) had increased from 15.3 to 20.4% implying deteriorated nutritional status. The survey results indicated a mean Dietary Diversity of 3.5 which is lower than 5. Food availability at household level was near-normal in the mixed farming livelihood zone as food stocks and milk were available. However, stocks were depleted in the pastoral-all zones and agro-pastoral livelihood zone and households were depending on markets for food. Food access was a challenge as maize prices, a staple in the county, increased significantly compared to the long-term average attributed to increased demand and low supplies in the county (SMART survey, 2017).

According to the Food Security Outcome Monitoring (FSOM) data, there is an increase in the proportion of population having poor and borderline food consumption in West Pokot County. Households in agro pastoral livelihood zone, consume two to three meals, and in pastoral livelihood zone one to two meals in a day. According to SMART survey, the proportion of underweight children increased significantly from 34. 6% in June 2016 to 36.8% in June 2017. General Acute Malnutrition (GAM) rates also increased to 15.3 from 12.4% recorded in 2016. Therefore, according to World Health Organization (WHO) thresholds, the County is therefore still classified as critical in terms of food insecurity.

Despite their importance in global and regional food production, smallholder farmers' especially in agro-pastoral regions have received minimal recognition in policy, strategic frameworks and interventions. In Kenya, there has been little focus by government and interventions on agriculture on smallholder farmers in agro-pastoral

regions, thus, rendering them into numerous vulnerabilities and constraints that impede their agricultural activities (Liru, 2014). Recent studies tend to examine specific constraints to smallholders' activities in general without focus on the influence of smallholder farmers and their associations to food security (Liverpool & Winter-Nelson, 2010; Reardon *et al.,* 2009; Markelova *et al.,* 2009). In contrast, this study therefore, investigated the influence and associations of smallholder farmers in household food security in agro-pastoral regions. As noted by FAO (2007), many of the constraints faced by smallholder farmers are socially and economically determined. Despite concerted efforts to mitigate these challenges faced by smallholder farmers, important data gaps on their contribution remain a major challenge.

1.3 Objectives of the Study

1.3.1 General Objective

The general objective of this study was to establish the influence of smallholder farmers and associations on household food security in West Pokot County, Kenya.

1.3.2 Specific Objectives

The following specific objectives guided this study:

i. To examine the role of socio-economic factors on smallholder farmers contribution to household food security in West Pokot County.
ii. To evaluate smallholder farming characteristics on household food security in West Pokot County.
iii. To analyse the role of farmers household labour conditions on household food security in West Pokot County.
iv. To determine the influence of climate variability on smallholder farmers activities towards achieving household food security in West Pokot County.

v. To establish how farmer association as a moderating variable influence the relationship between smallholder farming and household food security in West Pokot County.

   a. To examine how farmer association moderates socio-economic factors on smallholder farmers' contribution to household food security in West Pokot County.
   b. To evaluate how farmer association moderates smallholder farming characteristics in West Pokot County.
   c. To analyse how farmer association moderates smallholder farmers household labour conditions in West Pokot County.
   d. To determine how farmer associations influence adaptability to climate variability on smallholder farmers activities towards achieving household food security in West Pokot County.

1.4 Research Hypotheses

The following research hypotheses were formulated and tested in this study

i. **H_{01}**: There is no significant relationship between smallholder farmers socio-economic factors and household food security in West Pokot County
ii. **H_{02}:** There is no significant influence in the relationship on smallholder farming characteristics and household food security in West Pokot County
iii. **H_{03}:** There is no significant relationship between smallholder farmers household labour condition and household food security in West Pokot County
iv. **H_{04}:** There is no significant relationship between climate variability and household food security in West Pokot County

1.5 Scope of the Study

The study specifically explored the influence of smallholder farmers and their associations on household food security in West Pokot County, Kenya. It focussed on socio-economic factors, farming characteristics, household labour conditions and climate variability. These are the factors that seem to have a major effect on small hold farming in the study area. The study was limited to smallholder farmers in three sub counties based on land use classification (Kacheliba, Kapenguria and Chepareria).

1.6 Significance of the Study

The intention of carrying out this study was three pronged. First, the study aims to raise awareness on smallholder farmers' influence on household food security. Secondly, the study sought to fill an intellectual gap. As noted earlier, smallholder farmers contribute to household food security in agro-pastoral regions worldwide, and touches all spheres of human life such as education, health, survival and development and social wellbeing of people. Most of the studies on food security have delved on various issues influencing food insecurity. This study aimed to fill the existing knowledge gap has proposed by (Gustavsson *et al.*, 2011; FAO, WFP and IFAD, 2012).

Thirdly, at policy level, the findings of this study will directly inform the National Food and Nutrition Security Policy (NFNSP) at the National level while at the same time informing the County Integrated Development Plan. Maintaining the status of household food security requires action by a wide range of stakeholders such as smallholder farming households, organizations and the government. It also requires changes in technology, practices, behaviour and policy. These factors suggest that no single individual or group can sufficiently lead to food security. Therefore, this study was vital for policy level intervention since some of the employed interventions and

strategies have failed and have inadequate information that can help to offer practical solutions to the underlying problem.

1.7 Justification of the Study

The food security situation in West Pokot County is reported to be critical. The stressed levels of food security have been consistent in the agro pastoral zone. The situation is worsened by endemic livestock diseases, high food prices, recurrent droughts, insecurity, and cattle rustling. This comes at the backdrop of numerous smallholder farmers in the county. Smallholder farmers, particularly in agro-pastoral regions play a critical role in improving household food security, however, there contribution is undocumented, underestimated and underappreciated (Thamanga-Chitja & Morojele, 2014). This implies that it is difficult for government and other global institutions to come up with policies that would enhance the contribution of smallholder farmers towards food security.

In agro-pastoral regions, smallholder farmers are exposed to shocks and stresses that affect their livelihoods. They experience prolonged droughts, heat waves, increased dry seasons and reduced rainfall seasons which lead to frequent livestock deaths, human disease outbreaks, crop failure, reduced yield and food insecurities (Ubisi, Paramu & Unathi, 2017). Food security issues of agro-pastoral communities differ from those faced by the transhumance, pastoral and mixed farming communities. This may grossly be attributed to the nature of agrarian diversification, land use pattern, soil degradation and the agro-climate prevailing in the area. Moreover, unlike pure pastoralists, agro-pastoralists have settlements and hence, wide range movement is mostly limited.

In many countries governments have failed to implement land reform programs that guarantee equal land rights for farmers. They support large-scale commercial farming

rather than smallholder farming (and most have reduced their budgets for agriculture). In many of the local government structures that allocate land and their land rights are often overlooked. Some governments sell or lease public land to private companies or foreign governments. This is a threat to the rights of smallholder farmers who are farming on public land. Finally, during war and other conflicts, many small holder framers are displaced and some end up losing their land. In Latin America, smallholder farmers occupy almost 35% of total cultivated land (Altieri, 2009). There is substantial variation among smallholders according to livelihood assets and strategies, such as the share of crops produced for subsistence and for local and export markets (Nagayets, 2005; Murphy, 2010).

1.8 Limitations of the Study

The vastness and heterogeneity of the study area was addressed by proportionately distributing respondents as per population census and choosing the most appropriate sampling technique. This study suffered from some few instances of non-response. In some cases, some respondents were apprehensive about the motive of the study leading to providing information which is not accurate thus affecting validity of collected data. The researcher guaranteed the respondents that this study was purely academic and the information that was provided was treated with utmost confidentiality and their identity was kept anonymous. The sampled size was deemed adequate so as to enable generalization of the findings to the whole county as well as to various counties in Kenya. To address this limitation, the study selected a sample that is very representative coupled with selection of respondents with extremely high variability.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This chapter delves into smallholder farming and food security. The chapter examines concepts of smallholder farmers and food security at global, regional and local perspectives. This chapter also presents role of smallholder farmers' socio-economic factors on household food security, smallholder farming characteristics on household food security, role of farmers' household labour condition on household food security and influence of climate change on the contribution of smallholder farmers to household food security. The researcher did a critical review of the literature in order to ascertain the missing link. Finally, conceptual and theoretical frameworks that guided the study are also presented.

2.1 Key Concepts

Although food security refers to the availability of food and people's ability to access it, food security can be a confusing concept because it is a complex and sometimes multifaceted problem involving different interlinked aspects (McDonald 2010; DEFRA, 2006). The definition of food security has changed with time. For example, the 1974 World Food Summit definition focused largely on food supply, defining food security as "availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices" (FAO, 2016). In the early 1980, the definition of food security used by FAO (1983) was expanded to include both the physical and economic access as vital components of food security, a concern that was incorporated into later definitions as well, such as the 1996 Rome Declaration on World Food Security (Rome Declaration 1996). In 2001, FAO further redefined this idea, adding "social access"

(asking whether all household members have equal access to food) into food security, establishing the definition used today: “Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (FAO, 2009). What all the definitions have in common is not only the availability of food supplies, but also the ability of all people to gain access to sufficient amounts of nutritious food for an active and healthy life (McDonald, 2010).

Food insecurity in Kenya is classified as either chronic or transitory. Chronic food insecurity results from a continuous inadequate access to food and is caused by chronic inability of household to either produce or purchase sufficient food, whereas transitory food insecurity is the inadequate access to food due to instability in food production and food supplies. The most common food problem in Kenya is usually transitory in nature. This has been exemplified by: - periodic droughts over the years, institutional failure and poor policies which cause food crop and livestock production to decline forcing the country to import substantial food stuffs. While food crisis in the Arid and Semi-Arid Lands (ASALs) has always been attributed to climatic and environmental condition, other equally important factors have been documented. These include limited alternative sources of income, exploitative cereal marketing channels, unavailability of drought and disease resistant crop varieties, low limited crop diversification, poor storage methods, lack of credit services, inaccessibility to agricultural services, illiteracy and poverty (Mayanga *et al.,* 2003).

The transitory food insecurity households are those that, under normal circumstances are able to produce enough stock, but are vulnerable to supply problems, when external shocks affect their food production systems or distribution chains for a limited period

of time. The constitution of Kenya, 2010 (article 61-1) recognizes that all land in Kenya belongs to the people of Kenya collectively as a nation, communities and as individuals. However, a large percentage of Kenyan population is still faced with landlessness, while scenarios of large chunks of idle land owned by the state or individuals, including non-citizens still exist. Land tenure systems and land distribution has been so inconsistent and discriminative to an extent that food production has highly been affected.

For food security to be assured, availability, access, and utilization need to be stable over time. Even if people's food intake is adequate today, they are still considered to be food insecure if they have inadequate access to food on a periodic basis, risking a deterioration of their nutritional status. The role of government is to plan and set adequate strategies that enable their populations to be food secure all the time. Stability refers to the temporal determinant of Food and Nutrition Security (FNS) and affects availability, access, and utilization (Gross & Webb, 2006).Stability makes it possible to distinguish between chronic and transitory food insecurity.

2.1.1 Household Food security and its Dimensions

2.1.1.1 Availability of food

Availability of sufficient food refers to the overall ability of the agricultural system to meet food demand (Schmidhuber & Tubiello, 2007) and it is achieved if adequate food is ready to have at people's disposal (Gross, 2000). Availability refers to the physical existence of food, whether from the household's own farm or garden production or from domestic or international markets. It is defined by According to the United States Agency for International Development USAID (1992) as when: "Sufficient quantities of appropriate, necessary types of food from domestic production, commercial imports,

commercial aid programs, or food stocks are consistently available to individuals or within their reach."

Therefore, food availability addresses the "supply side" of food security and is determined by the level of food production, stock levels and net trade. The paradox regarding food availability and food insecurity is that national self-sufficiency is neither necessary nor sufficient to guarantee food security at the individual level (Schmidhuber &Tubiello, 2007). As examples, Hong Kong and Singapore are not self-sufficient (agriculture is non-existent) but their populations are food-secure, whereas India is self-sufficient but a large part of its population is not food-secure.

Adoption of new technology depends on many things, including the availability of required assets to implement the technology, how local women and men view the perceived benefits, the way information is shared, and local gender roles and other socio-cultural constraints (Ersado, 2006). Even when women have access to land for food production and access to improved technologies, they face more constraints than men in accessing complementary resources for success. They have less access to credit and less access to inputs such as fertilizer, and they are less likely to benefit from agricultural extension services and therefore they have less access to improved technologies. Women tend to process their crops more on the farm than men do theirs, but little is invested in technology research into on-farm crop processing (Esenu, 2006).

2.1.1.2 Access to food

Access refers to the resources individuals have at hand to obtain appropriate foods for a nutritious diet. It is defined by USAID (1992) as when: "Individuals have adequate assets or incomes to produce, purchase, or barter to obtain levels of appropriate foods needed to maintain consumption of an adequate diet/nutrition level." Individuals obtain

food through own food production and consumption (including wild food gathering), purchases in the market place, or in-kind transfers or loans from relatives, members of the community, the government, or foreign donors private citizens. An individual's ability to access food from these sources is in turn determined by their asset endowment and by the social, economic, policy, physical, and natural environments, which define the set of productive activities they can pursue in meeting their income and food security objectives. Food access is also influenced by the aggregate availability of food through the latter's impact on supply and, therefore, prices in the market (Langworthy, *et al.,* 2003).

Adequate supply of food at the national or international level does not in itself guarantee household level food security. Food availability for the nation as a whole or even for the world as a whole does not necessarily translate food availability to all sections of a given community or of each individual household (Enyedi, & Volgyes, 2016). Access refers to the household's or individual's command over food (Sen, 1981), and it is ensured when all households have sufficient resources to obtain appropriate foods (through production, purchase or donation) for a nutritious diet (Gross, 2000). In addition, Pinstrup-Andersen, and Watson, (2011) discusses access to food using the term 'entitlement' and they say that the entitlement of a person stands for the different alternative commodity bundles that a person can acquire through the uses of various legal channels of acquirement open to someone in his position. The entitlement relations of individuals are determined by what they own, what they produce, what they can trade, and what they inherit or are given.

2.1.1.3 Food utilization

Utilization refers broadly to the actual food that is consumed by individuals; how it is stored, prepared, and consumed; and what nutritional benefits the individual derives from consumption. It is defined by USAID (1992) as cited by Chant (2016) as when: "Food is properly used; proper food processing and storage techniques are used; adequate knowledge of nutrition and child care techniques exist and are applied; and adequate health and sanitation services exist." While important for its own sake as a determinant of human well-being, food utilization also has feedback effects through its impact on the health and nutrition on individuals and thus on their labor productivity and income-earning potential.

Food utilization has both a socio-economic and biological dimension. The socio-economic dimension refers to decisions related to what food is consumed and how the food is allocated within the household (Chowa, Garforth & Cardey, 2013). Both decisions in turn are influenced by intra-household dynamics and social customs/taboos. Depending on these factors, individuals within households may have access to food but still suffer from food insecurity (Doss, 2014). Women and children are particularly more likely to suffer from food insecurity because of their relatively limited control over assets and relatively weak intra-household bargaining power.

The biological dimension of food utilization refers to the ability of the human body to take food and transform it into energy for daily activities or to store it for future energy needs. Food utilization interacts in complex ways with diet, nutritional status, the functioning of the immune system, and health and hygiene practices (Mbuthia, 2017). In this context, food utilization requires a healthy diet, a healthy body, and a healthy physical environment, including safe drinking water and hygienic sanitary conditions.

It also requires a practical understanding of proper health care, food storage, food preparation, and feeding practices, along with the associated behaviours.

Utilization is only discussed from a biological perspective and it encompasses all food safety and quality aspects of nutrition; its sub-dimensions are therefore related to health, including the sanitary conditions across the entire food chain (Gross, 2000; Schmidhuber & Tubiello, 2007). It is not enough that someone is getting what appears to be an adequate quantity of food if that person is unable to make use of the food. This is where food security and nutrition get connected. People are food secure if the food intake at their disposal is beneficial to their bodies and if their bodies use the food intake in a healthy and nutritious way. Utilization also refers to the proper use of food and includes the existence of appropriate food processing and storage practices, adequate knowledge and application of nutrition and childcare and adequate health and sanitation services (FAO, 2014). This dimension is not relevant for the present study due to its biological character and it won't be developed further.

Smallholder farmer's role in food utilization for food security is perhaps the most critical and outweighs the importance of their role in food production and how they spend the income they earn. Mostly, they may typically be responsible for food provision and thus are crucial to the dietary diversity of their households.

2.1.1.4 Food Stability

Food stability is the fourth component of food security that cuts across the other three. Stability refers to the temporal dimension, or period, of food security as implied by the wording "at all times" in the USAID definition of food security. Stability is defined as, "The ability to access and utilize appropriate levels of nutritious food over time" (FAO, 2014).

An important distinction is made between chronic food insecurity and transitory food insecurity (World Bank, 2007). Chronic food insecurity is the long-term or persistent inability to meet food needs, whereas transitory food insecurity is a short-term food deficit. Transitory food security is sometimes divided into two sub-categories: cyclical food security and temporary food insecurity. Cyclical (or seasonal) food insecurity occurs on a routine or predictable basis, for example, the 'lean season' that occurs in the period just before the harvest. Temporary food insecurity occurs for a limited time due to unforeseen and unpredictable circumstances (World Bank, 2007).

In practice, transitory food insecurity and chronic food insecurity are closely linked. Successive bouts of transitory food insecurity may increase individuals' vulnerability to chronic food insecurity if it leads them to liquidate their productive assets to stabilize food consumption.

Chronic food insecurity means that a household runs a continually high risk of inability to meet the food needs of household members (Maxwell & Smith 1992). In contrast, transitory food insecurity occurs when a household faces a temporary decline in the security of its entitlements and the risk of failure to meet food needs over a short duration. This category can be further divided into cyclical and temporary food insecurity. Temporary food insecurity occurs for a limited time because of unforeseen and unpredictable circumstances while cyclical or seasonal food insecurity occurs when there is a regular pattern in the periodicity of inadequate access to food (CIDA, 1989). For food security objectives to be realized, all the dimensions must be fulfilled simultaneously in order to make sure that all people, at all times have access to the food that enables them to live an active and healthy life.

2.2 Theoretical Framework

According to Kombo and Tromp (2009), theoretical framework is a collection of interrelated ideas based on theories. Theoretical framework accounts for and explains the phenomena attempting to clarify why things are the way they are, based on the theory. This study was guided by entitlement Theory, Farming Systems Theory and the basic needs theory.

2.2.1 Entitlement Theory

This study was guided by The Entitlement Theory. This Theory was developed by Nobel Laureate Amartya Sen in 1977 in his famous book "Poverty and Famines: An Essay on entitlements and Deprivation." The approach broke with the traditional view of famine analysis referred to as the Food Availability Decline (FAD) approach. The FAD approach was a response to the Malthusian focus on population growth as a problem in itself. According to the FAD approach, the cause of famine was that food production was concentrated geographically or in time. Some countries or regions did not have enough food during a particular period of time to prevent famines. Natural disasters, inadequate production techniques or lack of infrastructure could all contribute to lack of food. Accordingly, his approach focused on food production capacities. The entitlement theory is based on three conceptual categories:

i. The endowment set
ii. The entitlement set
iii. The entitlement mapping (e-mapping)

The endowment set is the combination of all the legally owned resources by a person conforming to established norms and practices. These include tangible assets like land, equipment, and animals. The intangible assets are such as knowledge and skill, labor, power and membership of a particular community. The entitlement set is the set of all

possible combinations of goods and services (not just the one actually being enjoyed) that a person can legally obtain by using the resources of his endowment set. This can be in the form of production, exchange or transfer.

The entitlement mapping (e-mapping) is the relationship between the endowment set and the entitlement set. It is the rate at which the resources of the endowment set can be converted into goods and services included in the entitlement set. According to Sen, famine is not caused due to shortage of food but due to failure of entitlements. A person suffers from failure of food entitlement when his entitlement set does not contain enough food to enable him to avoid starvation in the absence of non-entitlement transfers such as charity. Since entitlement set is derived by applying e-mapping on the endowment set, the entitlement failure and this famine can occur only through some adverse change either in endowment or e-mapping or both.

There are two types of famines – one is caused due to change in endowment and the other, due to change in e-mapping. Another way of analyzing famine is that e-mapping consists of three different kinds of relations: production, exchange and transfer. Therefore, famines can be caused due to the following reasons:

i. Endowment loss
ii. Failure of production
iii. Exchange failure
iv. Transfer failure.

The idea of entitlements helps to draw attention to the importance of distribution rights in determining access to food and overcomes the narrow focus on food availability. However, there is another deeper level of inequity. Entitlements are not determined in

perpetuity; they are often changed through negotiation, bargaining, conflict, over-ruling, force, and redistribution of resources.

Most of the smallholder farmers in Africa have no access to assets such as major equipment that can help them in farming. The intangible assets are such as knowledge and skill, labor, power and membership of a particular community are also key in determining the contribution of the small holder framers to household food security. Therefore, if they were given their entitlements, then the issue of household food security would be addressed.

The Entitlement theory was therefore applicable to this study conducted in West Pokot County because the variables used are assumed to be endowment sets that can assist provide food security to the households. In the same vein, the small holder farmers in West Pokot County seemed not to have the goods and services that can be obtained by using the resources aforementioned. This is a further disadvantage for the household heads in ensuring household food security.

2.2.2 The Farming Systems Approach

The Farming Systems Approach emphasizes on the need to view the situation (farm household) as a whole and not in separate part. It consists of the totality of the physical, biological, social and economic surroundings. The Farming System Approach recognizes farming systems operated by smallholder farmers are not only complex but are affected by many factors both internal (resources, people, culture) and external factors (input supplies, credit and market). It recognizes interaction of components in the process of transforming inputs to outputs. The operator of the farming system is the farmer or the farming household. The farming system approach stresses a system

hierarchy, whereby every system is part of· a larger system and consists of subsystem (FAO, 1995).The Farming System Approach has four basic components:

Inputs: are goals, demands, events, resources or value put into a system and are transformed by throughput process into outputs or outcomes. Goals are valued objectives or anticipated outcomes that give direction and orientation to action. Values are essential meanings related to what is desirable or has worth. Events are expected occurrences that require some action. Demands are either goals or events that require some action. Resources are means capable of meeting demands and may either be material or human. In the farming system inputs are land, labour, capital and objectives (FAO, 1995).

Throughput: is the transformation or conversion of inputs by a system to output. This comprises of planning, deciding implementing and controlling. Decision-making is a process .of choosing between alternatives. Planning involves setting standards and sequencing action so as to meet the demands. Implementing is putting plans ill effect. Communication is the process of using messages to produce messages in the minds of others. Controlling is checking whether actions conform to plans and making adjustments when necessary (Deacon & Firebaugh 1988; FAO, 1995).

Outputs are the matter, energy information or processed resources produced by a system in response to input or transformation. Thus they include demand responses and resource changes. Demand responses are output-related value and satisfaction. Resource changes are outputs related to human or material resources and are either decreased or increased (Deacon & Firebaugh, 1988). Outputs in the Farming Systems Approach are to farm products such as livestock, crops, and income.

Feedback is the positive or negative response to action that re-enters a system as input to affect succeeding output (Deacon & Firebaugh, 1988).

The Farming System Approach focuses on the farm household as a system because it is a decision-making unit, which is ultimately controlled by; exogenous factors (social environment) contribute to what the smallholding farmers can do (Deacon &Firebaugh, 1988). These factors can be sub-divided into three broad groups: Community structure, norms and beliefs. External institutions include credit and input distribution system and markets on the output side and other influences such as population density, location and infrastructure. All these factors seem to affect the contribution of smallholder farmers to food security.

However there are other factors, which the farm household controls such as land, labor and capital. In this study, the input component of the farming household consisted of resources, which are land, capital and labor. The throughput process is the decision-making (control), knowledge and skills. The outputs are the products obtained from the farm such as crops, livestock, income, off-farm enterprises and markets which affects food availability, accessibility, utilization and stability.

On overall, the Farming System Approach used in this study provided a holistic framework for understanding the dynamic resource flows, functional spheres and inter-relationships among inputs, throughputs and outputs on the contribution of smallholder farmers towards food security (Deacon & Firebaugh, 1988). Therefore, the concept of farmer association resonates with this theory as it falls under the throughput stag where skills are learnt by the smallholder farmers.

2.2.3 Basic Need Theory

A basic needs theory approach to development is one which gives priority to meeting the basic needs of all the people. The actual content of BN has been variously defined: they always include the fulfillment of certain standards of nutrition, (food and water), and the universal provision of health and education services. They sometimes also cover other material needs, such as shelter and clothing, and non-material needs such as employment, participation and political liberty.

The idea of making the meeting of certain fundamental human needs a development priority is neither a recent idea nor a sophisticated one; it stems from the simple view that development should be concerned with removing absolute deprivation, as a first priority. This idea finds rhetorical echoes in the speeches of almost every statesman in developing countries, and every preamble to a development plan. But when it comes to translating the idea into action and into plans, policies and projects the achievement of BN becomes more complex, both in terms of identifying the appropriate measures, and in terms of mobilizing the required political will.

Since the Basic Needs Approach (BNA) constitutes an attempt to come to grips directly with poverty in the areas of food, nutrition, health, education and housing, and because it is predicated on a policy consisting of relatively high growth rates, redistribution of income, reorientation of investment and a review and modification of consumption and production pattern, it can be said to provide the foundation for rapid economic development.

The Basic Needs Approach is applicable to the present study because it highlights the motivation that smallholder farmers have in their bid to be food secured. Also, it aligns to the socio-economic construct that is part of the current study variables. The construct

is viewed within the lenses of basic needs and the priority that comes with the considerations of these basic needs.

A critical look at the three theories; the Entitlement Theory, The Farming Systems Approach and the Basic Needs Approach shows that they complement each other. While the Entitlement Theory is primarily concerned with explaining the famine phenomenon and how farmers can leverage their Agro-pastoral resources to mitigate the famine, the Farming Systems Approach considers the mechanisms that can be used to actualize best-practice processes to help smallholder farmers produce more. The motivation for smallholder farmers to engage robustly in farming practices to help them become food secured is handled by the Basic Needs Approach. The entitlement Theory however better aligns with most of the variables that underpin the current study (Socio-economic factors, Household characteristics, Farm size) and as such, this becomes the study's anchor theory.

2.3 Review of Empirical Literature

This section reviews empirical literature of the study objectives.

2.3.1 Smallholder Farmers' Socio-economic Factors on Household Food Security

There is a continuing debate on the implication of socio-economic factors to food security amongst policy makers, social scientists, development workers and local people involved in promoting food security in developing countries (FAO, 2014). Literature has supported that socio-economic activities of smallholder farmers has a negative or positive contribution towards achieving food security (World Bank, 2010; Yahya & Xiaohui, 2014).

2.3.1.1 Source and Control of Income

Most smallholder farmers in rural Kenya have access to informal credit but typically in small amounts, (Mutoro, 1997). This informal credit includes merry-go-round, which is a major way of saving among farmers in Kenya. Difficulty in obtaining credit from the formal sector, such as banks, may inhibit the use of inputs and constrain production Indications are that Kenyan smallholder farmers could substantially increase their yields through use of improved seed, fertilisers and other inputs. Research done in Muranga and Meru found that lack of cash kept smallholder farmers from using more fertilisers, seed and other inputs (World Bank, 2008). This of course reduced the output. Very few smallholder farmers have access to formal credit. Some households however have husbands who provide some credit indirectly. In a study done in Kakamega, husbands were willing to allow their wives to seek credit if neither land nor family property was pledged as security, which effectively eliminated formal credit for women. Moreover, women could not seek credit without their husband's permission (World Bank, 2008).

Smallholder farmers cannot apply for loans (capital) from banks or other financial institutions because of a number of obstacles like high interest rate, limited amount of loan that can be applied, collaterals barrier and short period for repaying the loans. Eriksen (2008) revealed that demand for collaterals and/or guarantors, high interest rate, tightness of the deadlines for repaying the loans, frequency of repayment schedules, the rigorous procedures for obtaining loans as well as restrictions on the amount of loan allowed are among obstacles on the way to credit services for smallholder farmers in Addis Ababa.

Yahya and Xiaohui (2014) asserted that inability to access to resources such as land and capital constrain smallholder farmers effort towards ensuring food security at households. The study also finds out that the majority of smallholder farmers have few assets and they only depend on land as collateral for capital/credits. Moreover, even though discrimination in land and property rights based on sex or religion is prohibited by the Tanzanian constitution, but customary law limit women's rights, they are given access to family or communal land whereas their rights can be deprived in the course of divorce or widowhood.

Studies conducted in Limpopo, South Africa revealed that although smallholder farmers are engaged in household food production, usually they are left with food deficits to carry them to the next harvest and would require off-farm income to buy food for the household (Aliber & Hart, 2009). In addition, those off-farm income are essentially part of being a smallholder farmer in South Africa since they help to diversify their incomes and hence their livelihood sources. These off farm activities act as a survival strategy for these farmers to help them in case of crop failure or poor harvest. Similar studies conducted in Kenya indicate that those with diverse sources of income are likely to be more food secure than those who solely depend on agriculture (Orodho, 2009).

Various studies have explored the relationship between household power dynamics, agricultural production and food security in developing countries. Rao (2006) explored the conceptual linkages between the issues of land rights for women, with household food security on the one hand and gender equality on the other. Rao (2006) found that men have been able to access the better paid, non-farm jobs, while leaving women behind to manage agricultural production. Rao (2006) argued that while a right to land

for women is a positive development, it appears also to be leading to an enhancement of work burdens, without much change in terms of status or decision-making authority.

Njuki *et al.,* (2011) used data from Malawi and Uganda to analyse the influences of income distribution between men and women. The results indicate that commodities generating lower average revenues are more likely to be controlled by women, whereas men control commodities that are high revenue generators, often sold in formal markets. Another study by Ismail, Rajeani, Idris and Akoge (2015) in Nigeria highlighted the role of gender in decision making. The results show that although men generally wielded greater decision-making power at the household level, women exploited their social spaces and gender roles to (re)negotiate significant roles in decision-making in urban gardening. Nonetheless, there were notable gender differences in terms of the initial decision to farm, choice of crops to cultivate, and use of crop products and income.

According to URT (2005) access to credit is among factors that improve agricultural productivity of smallholder farmers since its availability will enable farmers to adopt modern and improved farming technologies that will increase food availability. In addition, credit will provide smallholder farmers opportunity to engage in non-farming activities that will enhance food accessibility. However, rural smallholder farmers in Tanzania have inadequate reliable sources of credit (formal and informal) that farmer could depend upon. Demand for credit exists because farmers do not have access to all inputs required for farming activities. FAO (2012) reported that, a large percent of rural smallholders who are poor suffer from insufficient access to loans and credit.

2.3.1.2 Land Ownership

Most studies have shown that, women in Africa are less likely to own land and usually enjoy only use rights, mediated through a man relative. Studies cited in Deere and Doss (2006) indicate that women held land in only 10 percent of Ghanaian households while men held land in 16–23 percent in Ghana; women are 5 percent of registered landholders in Kenya, 22.4 percent in the Mexican ejidos (communal farming lands), and 15.5 percent in Nicaragua. On average, men's land holdings were almost three times the women's land holdings. This compromised land access leads women to make suboptimal decisions with regard to crop choices and to obtain lower yields than would otherwise be possible if household resources were allocated efficiently (World Bank, 2007).

In their study, Copeland and Guertin (2013) assert that women produce fifty per cent of the world's agricultural output, but own approximately two per cent of its land. It is true that food security cannot be achieved without women but they encounter many obstacles due to limited land rights which make it difficult for them to improve food security conditions for their families and their communities. FAO (2014) claims that women would produce 20 to 30 percent more food than men if they had access to the same resources as men such as land. This has the potential of removing 100 to 150 million people from poverty and malnutrition.

Therefore, to improve food security, According to De Shutter (2011), there is need to ensure equal rights to land and property, women`s participation in the market place and improved education opportunities for women. The removal and amendment of discriminatory land and labour laws would also help women farmers and food producers.

Copeland and Guertin, (2013) argue that the right to own, control and access land is fundamental to both food security and gender equality. Ownership, control and access to land can ensure that land is used to produce food for household consumption while the surplus can be sold to provide additional income that can be used to purchase food, or meet healthcare and other livelihood needs. Citing the World Bank, Copeland and Guertin (2013), state that property ownership for women increases their bargaining rights, improves family stability and boosts household economies. Most international statutes and national constitutions protect gender equality, especially with regard to land and other property rights, as well as education and general food security but this does not always translate into practice due to traditions and social norms that regard men as the owners and custodians of family land.

Most rural Ghanaian women have less access to economic and productive resources, and are generally discriminated against in personal and social relationships and all these combine to making their households more food insecure. According to Kameri-Mbote (2005), access to, control over and ownership of land is influenced by diverse factors which include gender, age and marital status. Land in Kenya is mainly controlled by male household heads on the assumption that they hold in trust the rights for all members of the household.

2.3.1.3 Education Level

Education is typically seen as a means of improving people's welfare. Studies indicate that inequality declines as the average level of educational attainment increases, with secondary education producing the greatest payoff (Cornia &Court, 2001). There is considerable evidence that even in settings where people are deprived of other essential services like sanitation or clean water, children of educated mothers have much better

prospects of survival than do the children of uneducated mothers. Education is therefore typically viewed as a powerful factor in levelling the field of opportunity as it provides individuals with the capacity to obtain a higher income and standard of living. By learning to read and write and acquiring technical or professional skills, people increase their chances of obtaining decent, better-paying jobs (KNBS & SID 2013).

Education however can also represent a medium through which the worst forms of social stratification and segmentation are created. Inequalities in quality and access to education often translate into differentials in employment, occupation, income, residence and social class. These disparities are prevalent and tend to be determined by socio-economic and family background. Because such disparities are typically transmitted from generation to generation, access to educational and employment opportunities are to a certain degree inherited, with segments of the population systematically suffering exclusion. The importance of equal access to a well-functioning education system, particularly in relation to reducing inequalities, cannot be overemphasized.

Education is thought to influence the food security status of households. Educational attainment by the household head could lead to awareness of the possible advantages of modernizing agriculture by means of technological inputs; enable them to read instructions on fertilizer packs and diversification of household incomes which, in turn, would enhance households' food supply (Najafi, 2003).The education of women is known to produce powerful effects on nearly every dimension of development, from lowering fertility rates to raising productivity, to improving environmental management. Women are fully effective in contributing to food and nutrition security, discrimination against them must be eliminated and the value of their role promoted.

Many studies have revealed that the level of education helps the household head to use production information efficiently as a more educated person acquires more information he becomes a better producer (Hayami, 1969, Lockheed *et al.*, 1980, Phillips 1994, Wang *et al.*, 1996, Yang 1997). The level of education is believed to influence the use of improved technology in agriculture and, hence, farm productivity. The level of education determines the level of opportunities available to improve livelihood strategies, enhance food security, and reduce the level of poverty. It affects the level of exposure to new ideas and managerial capacity in production and the perception of the household members on how to adopt and integrate innovations into the household's survival strategies.

Lack of education is the main cause of poor agricultural productivity in Kenya. It is a known fact that education contributes significantly to sustained rural income growth since education increases the ability of farmers to allocate their resources more efficiently and know the nutritional value of the foods they consume. Furthermore, education will help the smallholders to develop the skills needed to participate in knowledge intensive agriculture, adopt new technology and participate in marketing activities. Gender inequality and discrimination at the household level prevent women from getting education which, in turn, has a negative impact on their decision making, production and marketing skills and contributing even more to food inequality in their households (AWSC & KNBS, 2014).

2.3.2 Smallholder Farming Characteristics on Household Food Security

This section looks at the various dimensions studied under the smallholder farming characteristics.

2.3.2.1 Farm Size under Cultivation

The size of the family land determines the amount of food produced. Households with less land are unable to produce more and therefore become food insecure. Orodho, (1998) in a study conducted in Vihiga district, of Western Kenya, also found that families that had more land were more food secure than those with less land. In Kitui County, food production is carried out on farms that are generally small averaging 0.2-3 ha and without irrigation. This already scarce resource must be subdivided among more people, resulting in over-exploitation and low productivity (KNBS & ICF Macro, 2010). In addition, household farm size in Kitui County determines household food security although the biophysical agricultural potential is mainly a function of soil characteristics and moisture availability, both being largely controlled by elevation and topography.

The majority of smallholder farmers are the poor. Matshe, (2009) indicates that 50% of the worlds' hungry are smallholder farmers, with the landless rural population making up 20% of these. There is increased attention over the past few decades on studies that attempt to link household characteristics to household food security. This attention arose upon the realization that components of economic and social status that distinguish and characterize people are significant indicators of food security (Dauda, 2010). The size of a household farm is an important characteristic in understanding household food security (Orodho, 1998). It is the total area of land cultivated to food and cash crop by households, measured in hectares. Deininger & others, (2003); Jayne *et al.,* (2006) demonstrates that there is a positive relationship between farm size and improvement in households' income and food security.

Orodho, (1998) states that the quantity of food produced is significantly influenced by the size of land at the disposal of the household. In sub-Saharan Africa and Asia, Salami *et al.*, (2010) indicated that eighty percent (80%) of the farmland is managed by smallholders who work on up to 10 hectares. The influence of farm size in Ethiopia was observed as positively and significantly related to the probability of a household being food secure and that this probability increased by 6% for every increase of one hectare of farm size (Haile *et al.*, 2005).

In Kenya, the mean land owned per household has declined over the past decade, from 6.1 to 5.8 acres. This is attributed to increasing rural population pressures and land fragmentation (Kibaara *et al.*, 2008). He further states that household farm size in Kenya has a significant relationship on household food security. Where households with smaller lands tend to intensify labor input because smaller field size tends to be correlated with increased labor/land ratios hence increase food production. Smaller farms have higher adult equivalent per acre for example compared with bigger size farms explaining the high labor input. In addition, smaller fields tend to be more mixed cropped than larger fields and these mixed crops tend to include horticultural crops and other relatively high value crops.

This view contradicts that raised by Haile *et al.*, (2005) in the paragraph above as every increase of one hectare of farm size increased the chances of food security. In the Teso farming systems, Esenu, (2006) observed that the farm size owned by households had a positive impact on food security. The bigger the farmland the more food secure the family was. In Kisii County, the average farm size dedicated to food production has been decreasing and this has serious implication on household food security. Some of the factors contributing to this situation are diminishing land resource due to high

population density (1056 persons per square kilometer by 2012), continued sub-division of arable land resulting in reduced average land holdings (about 0.5 hectares), and a poverty level of about 54.2% which is associated with negative influence on agricultural production and income levels (Kisii County, 2013).This poses a problem to the ability of household to secure enough food and require addressing. Orodho, (1998) in a study conducted in Vihiga district using household food production as the criterion for determining food situation, found that farm size influence food production.

2.3.2.2 Type of Food Crops

According to Tankou *et al.,* (2017) in Cameroon and Herbert, (1996) in Burundi, there is a tendency towards income diversification through extra-agricultural activities which complement farming and increase food security of the household. Some farmers in Burundi have even adopted the growth of passion fruit following its high market demand to broaden their sources of income and this enhances their food security (Bashangwa Mpozi *et al.,* 2015).

The Asia and Pacific region can increase food production through crop diversification, making the best use of alternatives to rice and wheat. For example, potato has emerged as one of the important food crops in the region. Since it gives an exceptionally high yield and produces more edible energy and protein per unit area and time than many other crops, it fits well into multiple-cropping systems prevalent in the region. Since many potato varieties are bred for conditions in Europe and the United States (US), researchers are testing promising varieties under local growing conditions. The PRC and India are leading the way, accounting for about 79% of the land area allotted and production of potato in the region. There is scope for more research on improved

varieties, appropriate production technologies, and value addition (Papademetriou, 2008; Thiele *et al.,* 2008).

Smallholder farmers have been found to tend crops that have been neglected but they are essential in achieving food security and nutrition. There is also a real opportunity to increase productivity in many secondary crops that have been neglected and bypassed by mainstream agricultural research. These "orphan" crops, such as millet, sorghum, cassava, and other root crops, provide the main sustenance for millions of poor households (Naylor *et al.,* 2004). The International Center for Agricultural Research in the Dry Areas (ICARDA) has been working for decades on the development of disease-resistant, yield-increasing cultivars of millet, and recently, there has been a strong interest from the research community and policymakers to revitalize millet production as a means of addressing food security challenges. Leading universities and nongovernment organizations in South Asia, in collaboration with Canadian researchers, are finding ways to bring the underutilized small grains back into the South Asian diets through multidisciplinary research and policy advocacy

2.3.2.3 Farming Practices

Yahya and Xiaohui (2014) indicated smallholder farmers efforts are constrained by their inability to access agricultural inputs like seed, fertilizer and pesticides when needed. This was consistent with the study from Kenya, which revealed that female headed households have much lower adoption rates for improved seeds and fertilizers. Credit constraints also limit the access of female-headed households to fertilizers in Benin and Malawi (Minot, Kherallah, & Berry, 2000). Ndiyo and Urassa (2001) also finds out that smallholder farmers' access to agricultural inputs and technologies is constrained by their lack of access to credit and membership in rural organizations,

gender-blind development programs and lack of attention to the needs of farmers in research.

Yahya and Xiaohui (2014) revealed a percentage increase in access to modern technology and agricultural extension education/ training to small holder farmers (ceteris paribus) increases the probability of being food secure and hence reduce constrain toward their effort in ensuring food security at households. Mechanized farming not only enables efficient utilization of various inputs such as fertilizers, pesticides, seeds, and use of water for irrigation, but also helps in improving yields and hence poverty alleviation. The majority of smallholder farmers are still practicing rudimentary farming, farming activities are done manually, which is time-consuming, since they can't afford to hire tractors/new technologies for food production (as to out 173 beneficiaries, only 62 are women while 111 are men). Furthermore, smallholder farmers are not only a key producer of food, but they also perform household chores, most of the time they do not have enough time to attend extension education/ training programs for existing/new technologies.

A study by Tegegne (2012) in Ethiopia revealed that 29.4%, of women had training on agricultural technologies, 50.3% had no training in agricultural technologies and 20.3% partially participate in training on agricultural technologies. This tends to constrain farmers' ability to improve yield, earnings and efficiency in agriculture.

Poor food storage facilities increase the probability of being food insecure and vice versa. Poor food storage facilities and use of poor processing methods constrain WSFs efforts in ensuring food security at households, this is due to the fact that it leads to high post-harvest losses of food and hence food insecurity. In line with this study Imonikebe (2010) pointed out that the provision of processing and storage facilities by the

government could minimize post-harvest losses and promote food security. Smallholder farmers play a greater role in every stage of food production, so in order to reduce food waste women should be empowered so that they can access modernized food storage facilities and food processing methods.

The issue of food losses is of high importance in the efforts to combat hunger, raise income and improve food security in the world's poorest countries. Food losses occur as a result of inefficiencies in food production and processing operations that diminish supplies (Rooney, 2011). Given that many small farmers in developing countries live on the margins of food insecurity, a reduction in food losses could have an immediate and significant impact on their livelihood. Food losses are among factors affecting food availability due to high pre and post-harvest losses due to pest, diseases and adverse climatic conditions. Pre harvest losses account for over 30% of all crop losses in the country. It is estimated that post-harvest losses range from 30-40% for cereal grain and legumes, up to 45% for roots and tubers and 40-80% for fresh vegetables and fruits. Moreover inappropriate food management at house hold level diminishes food stock available for consumption (IFAD, 2010).

2.3.3 Role of Smallholder Farmers' Household Labour Condition

The household labour conditions have a role on how the smallholder farmer ensures food security in the households. Various aspects of the householder conditions are discussed.

2.3.3.1 Freeing up Household Member's Time

Sub-Saharan Africa has one of the highest manual labour-force participation rates worldwide. In this region, women represent, on average, 50 percent of the labour force in the agricultural sector (FAO, 2011). Countries, whose economies depend heavily on

agriculture, have high female labour force rates. Niger, Lesotho, Mozambique, and Sierra Leone have some of the highest female labour force participation rates, as a matter of fact, women provide over 60 percent of the labour force in those countries (FAO, 2011).

Given their high participation in the labour force, it is not surprising that both genders get involved in several activities along the value chain of food production. In a study conducted by Herz and World Bank (1989), women performed 90 percent of the activities related to processing food crops, 80 percent of food storage activities and transporting marketable products from farm to village, 90 percent of hoeing and weeding, and 60 percent of harvesting and marketing. Additionally to these occupations, women farmers perform activities beyond their own managed fields. Quisumbing (1993) revealed that men must make decisions outside of their households e.g. when their skills are desirable or when the head of the household is working on urban area, which represents an additional burden for them. Sub-Saharan women play a central role not just in agricultural activities but in domestic activities. In their households, women are the primary caregivers and are concerned with providing the necessities for their children's' health and well-being (FAO, 2013). Although these activities are vital to the development of the future generation, many of these domestic activities are unpaid activities (Doss, 2011). In Kenya, women perform more activities than men not only in their home but also in field. In the household, women are responsible for preparing food, caring for their children and gathering firewood and water, and in the field women perform most of the cropping activities and help in raising the livestock (Saito, 1994).

The responsibility for providing care often falls disproportionately on women. As a result of their multiple responsibilities, women are often unable to spend sufficient time on food preparation, child feeding and other caring activities that have beneficial nutritional outcomes. Studies undertaken by the International Food Policy Research Institute (IFPRI) in Botswana, Ghana and Kenya (Brown & Haddad, 1994) and in Zambia (Kumar, 1994) pointed out that considering that children are valuable resources in terms of their contribution to productive activities, very little is invested in them in terms of direct care time. Time recorded in direct child care was generally less than one hour per day.

Household members often face difficult choices in their time allocation decisions. Although caution is needed in generalizing about people's time allocation patterns and burdens, recent data from different African countries support the popularly held belief that women not only work longer hours than men but also spend more hours in productive activities per day than men. Data from the region of Mbeya in the United Republic of Tanzania, a largely agricultural area, revealed that women worked 12 to 14 hours during the dry season and 14 to 17 hours during the wet season, without rest, whereas men worked eight to ten hours in the dry season and ten hours in the wet season, with a rest period of three to four hours (Mwalemba, 1995).

Seasonal constraints for household food security in agricultural and fishing communities often occur just before the harvest, when agricultural labour is at its peak, stocks from the previous year's harvest are nearly exhausted, and cash is running out. Shortages of food usually give rise to high market prices, which decline following the harvest. Women, who tend to perform a large proportion of the agricultural labour, have less time available for meal preparation and child care. The hungry season also

frequently coincides with the rainy season, especially where the rains are confined to a single season and are accompanied by an increased incidence of infectious diseases, particularly diarrhoea, respiratory diseases and malaria.

In combination, these factors often contribute to raise levels of malnutrition among vulnerable groups. In a study carried out in the Gambia it was observed that child morbidity and mortality tended to reach their peak in the pre-harvest period and that women whose last trimester of pregnancy coincided with this period tended to deliver babies whose birth weight was significantly lower than normal (Lawrence et al., 1989). The effects of low birth weight on children's capacity for survival and development. In addition, they are now cultivating crops and taking on tasks traditionally undertaken by men, and the women are also increasingly making decisions on the daily management of farms and households. With few exceptions, women fulfil these multiple jobs with little or no access to productivity enhancing resources and services such as credits and health care.

Household's activities in the food chain influence their resource situation in two ways. On the one hand, food and cash are generated through these activities; on the other hand, the labour and time spent in the process are diverted from food preparation and child care activities. The necessity for many women to play a dual role in the household - in production (food production and income generation, for example) and in reproduction (activities related to nurturing and attending to basic family needs) - imposes immense pressure on women's time, labour and attitudes. Often the physical labour involved may be so heavy that it is detrimental to the woman's health, especially during pregnancy and lactation. In such households, nutrition insecurity will be reflected also in higher levels of stunting and wasting among infants and preschool

children. This is particularly the case when access to basic necessities such as water and fuel wood for cooking involves carrying heavy loads and walking long distances every day.

2.3.3.2 Extra Labour

The major source of labour in many rural households is family members. Labour shortage is a constraint to the increasing food crop production. Matunga (2008) revealed that, labour shortage for farming activities by households is attributed by selling labour for farming activities in other people's farms and other off-farm activities. Selling labour during farming season contribute labour shortage hence household food insecurity. According to MAFSC (2006), migration of young people and men for wage work lead to decrease in food crop production. Baldwin (2006) added that, poor health (diseases like chronic malaria, typhoid etc.) has contributed to loss of labour for household agricultural production.

By most accounts, women in Tanzania take charge of weeding, harvesting, processing and storing food crops; they also contribute significantly to these tasks for cash crops, though men tend to help more with agricultural tasks for cash crops (National Sample Census of Agriculture, 1996; Keller (1999) cited in Ellis (2009). Accounts of specific divisions of labour differ, one source found that tasks in which men tend to contribute more include site clearing and land preparation and heavy-labour tasks like construction of fences. The project by FAO (2012) in Mogabiri, Mara region found that generally in crop production, men and women participate fairly equally in land clearance, land preparation, sowing and planting, while women take most responsibility for weeding, harvesting, transportation, threshing, processing and storage. National Sample Census in Agriculture (NSCA) data from 2002-03 found no significant difference between

men‘s and women‘s responsibilities for crop-related activities with data that was not disaggregated by cash and food crops. The analysis did find that men strongly dominated animal husbandry and construction. Conflictingly, another analysis of earlier NSCA data found significant differences between men‘s and women‘s agricultural responsibilities, and produced

2.3.4 Climate Variability and Food Security

Climate variability exerts a major role in household food security especially among one-third of the people living in drought-prone areas in Africa which are very vulnerable to the impacts of drought (Boko *et al.,* 2007). Small holder farmers are the most vulnerable to weather variability with multiple stresses occurring at many levels, limiting their adaptive capacity (Boko *et al.,* 2007). The same views are echoed by Baez, Kronick and Mason, (2012) who asserted that the poor households have limited choice for their livelihoods and restricted faculty to deal with climate variability and natural disasters. In addition, Aerts *et al.,* (2007), asserts that extreme climate variability is expected in East Africa in the future where the annual precipitation is expected to increase. He further states that temperatures will rise and potential evaporation will increase as well and hence net water availability is projected to decrease (Aerts *et al.,* 2007). It is likely that in many African regions, agricultural production and food security will be severely compromised by climate change and climate variability. At the present, there is already a high mortality risk because of food insecurity in many African regions including Kitui County (Boko *et al.,* 2007).

Serious repercussions arising from climate changes face Kenyan farming households (Okumu, 2013) who in many areas of the country are experiencing increased seasonal mean temperature. Considering the pivotal role that agriculture plays in the Kenyan

economy, an understanding of how climate change affects food security is important so that smallholder farmers can be guided appropriately. According to the GoK, (2009) the agricultural sector employs the majority of the populace with own production providing food for households. Furthermore, areas considered arid or semi-arid which are not suitable for rain fed agriculture due to low and inconsistent rainfall has mass of smallholder farmers (GoK, 2010). They therefore exhibit frequent crop failures and low crop and animal productivity.

These areas also have a high population and producing sufficient food poses an environmental dilemma. To sustain food security, food production need to be increased but growing more food damages the environment which reduces our chances of increasing food production in the future (Raven, Berge, & Johnson, 1993cited in Wolman, 1993). In addition, increasing food production may not translate to food security if the weather pattern and seasons continue to change as a result of climate change. These changes can disrupt food availability and quality whereby, as temperatures increase and precipitation changes and human activities that support desertification in arid and semi-arid lands (ASALs) increase, the effect is evidenced in reduced agricultural productivity (GoK, 2010).

Climatic changes that have been reported are intensified by global warming and since the small holder farmers depends on rain fed agriculture, any slight changes in weather from what they are used to has the ability to affect their livelihood. Agricultural producers are hard hit by these changes and household food security is compromised. This is because weather patterns and seasons are affected by climate variability and change which resultantly impinge on household’s capability to secure food.

In the ASALs, Miano, David, Rose and Lawrence, (2010) indicate that climate change has become more pronounced in recent years adversely affecting the lives and livelihoods of smallholder farmers. Kitui County being a ASALs area receives erratic and unreliable rainfall and is mostly hot and dry resulting to high evaporation rates (GoK, 2009).

In semi-arid eastern Kenya which includes Machakos, Makueni and Kitui Counties, Ongeko, (2011) reported that the climate variability is characterized by cyclical and persistent drought, now and then going for two to three years at a stretch. Due to the gravity of the issue of climate change and its implication on rural livelihoods, adaptation to climate change is important especially for rural producers. Adaptation refers to the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (Intergovernmental Panel on Climate Change (IPCC), 2001).The adaptation strategies in the agricultural sector include use of new crop varieties, crop diversification, adoption of mixed crop and livestock farming systems, changing planting dates and irrigation (Ndambiri, Ritho, Mbogoh, Nganga, & Muiruri, 2012).

Maddison, (2006) reported that farmers will first perceive a changing climate and then device practices in response to the perceived change. The perception of local farmers on climate change is therefore an important aspect towards successful climate change adaptation strategies.

2.3.4.1 Cutting Trees and Household Food Security

The environment faces many challenges arising from human activities by cutting existing forests, releasing materials that harm the environment like the spillage of pollutants like pesticides, soil exhaustion and poor land use methods. All these

challenges to the environment must be addressed and constructive solutions to the problem sought if small scale farmers are to realize food security. Land degradation is a serious problem which has effect on land that provides goods and services for livelihood at the individuals and the national level (Bach *et al.,* 2011). There is a decrease in agricultural production due to land degradation which results from human activities. These human activities compromise soil fertility which leads to a reduction in returns to be accrued by the farmer from the field as well as the integrity of the environment (Erkossa, Wudneh, Desalegn, & Taye, 2015).

Changes in forest or tree cover influences regional and global hydrological cycling due to their key role in the water cycle (Avissar & Werth, 2015). It is thus expected that deforestation would influence rainfall distribution as it interferes with the water cycle process. An analysis of changes in rainfall over Borneo forest in Indonesia reveals that there has been a constant decline in total annual rainfall between 1951 and 2007. The most abrupt decreases occurred in the 1980s, when intensive deforestation activities (primarily logging) occurred in search of timber for garden furniture, paper pulp and chopsticks (Kumagai *et al.,* 2013). This trend can also aggravate the possibility of extreme drought and forest fires, principal to even more deforestation.

Similarly, a modelling experiment in the Indochina peninsula reveals that deforestation is coupled to changes in hydrological course both close by and regionally. At the local level, the effects include higher temperatures and lower rainfall. At the regional level, it has been observed that there is a weakening of the monsoonal flow over east China, near the Tibetan Plateau, and a strengthening over the neighboring South China Sea (Sen, Wang, & Wang, 2004). This trend suggests that deforestation may be one of the key drivers of climatic change in the region that has a serious effect on food security.

Studies by UNEP, (2006) indicate that Africa is faced with a lot of environmental degradation and considering that 70 % of its population depends on the land for its survival, land damage is a serious issue. In addition, there is a lot of strain on agricultural productivity and food security in Africa arising from environmental degradation. For instance, the current threat of desertification observed on dry lands which constitute the home to about a third of the world's population. This reduces the adaptive capacity of these dry lands which affect the productivity of the lands and thus food insecurity become rampant. Human activities tend to create or worsen the environment through increased soil erosion and mineral depletion of the soil both of which occur globally. Water and wind are particularly effective in removing soil in the sense that rainfall loosens soil particles which is later transported away by moving water. Wind on the other hand loosens soil and blows it away especially if the soil is barren and dry. Because soil erosion reduces the amount of soil available for cultivation, it limits the growth of crops planted (UNEP, 2006).

Erosion causes a loss in soil fertility because important minerals and organic matter that are important components of the soil are removed (Garcia-Diaz et al., 2017). As a result of these losses, the productivity of eroded agricultural soils drops, and restoration of the fertility by using fertilizer or manure has to be done to replace the lost nutrients. Therefore, Soil erosion is one of the greatest causes of land degradation in Africa (Thomas, 1997). Deforestation enhances soil erosion by reducing the vegetation that would otherwise protect the soils. In addition, Ongwenyi, Kithiia and Denga, (1993) states that soil erosion is mainly due to surface water run-off from bare soil surface with the problem being more pronounced in the marginal lands, as a result of sparse vegetation cover, intensive deforestation, cultivation and overstocking.

These human activities often accelerates soil erosion with poor soil management practices where removal of natural plants during construction of roads or buildings and cutting trees for charcoal or brick burning increase erosion. The world forest is therefore being cut down with little replacing. Tropical low lands, or rain forest- biologically the richest areas on earth- have so far been reduced to half their original size. In Asia, Africa and Latin America, what remains is two thirds of the original forest cover and if the trend continues, most will be gone in the next coming years. Inefficient or short term exploitation with disorganized logging and clearing (often by burning) results in irreversible damage of the productivity of these lands (Raven *et al.,* 1993). Tree planting as a determinant to household food security ensures that agricultural land is protected from soil fertility losses and thus increasing or retaining the productivity of the land. According to GOK (2002), rapid population growth, high poverty levels, land use changes/ poor land use systems and deforestation (increase of farm lands and exploitation of existing forests for charcoal burning, fuel wood, construction materials and fodder), has worsened the state of land contributing to food crises.

Furthermore, it has also been observed by Erkossa *et al.,* (2015) that food security is affected by land degradation where habitat is lost a result of soil erosion and siltation which further led to land denudation and the reduction of agricultural potency of the land. Similarly in Makueni County, Kieti *et al.,* (2016) observed that bio-physical changes which affect agricultural production and eventual food security are mainly as a result of land use practices which degrade the environment. These practices also include cutting trees and clearing of vegetation for crop production and livestock pasturage, with consequent heavy losses of soil, have caused serious degradation of most areas in Kitui (Makenzi, 2000). Kironchi, Liniger, & Mbuvi, (2000) further argue

that depletion of soil cover due to cutting trees has adversely affected the soil physical properties.

2.3.4.2 Climate Change and Smallholder Farming

Many crops have annual cycles, and yields vary with climate variability, especially rainfall and temperature (IPCC, 2007). Stability of food supply when production is seasonal is hence challenging. Results for impacts on production are generally simulated in two different ways either climate-induced yield changes are projected without agronomic (farm-level) and economic (sector-level) change or different static cases are compared, with an agreed level of climatic change and an inflexible adaptation factor (Harrison *et al.,* 2016; Adams *et al.,* 1999; Darwin, 1999; Parry *et al.,* 2004).

Climate change is shifting the distribution of animal pests and plant pests and diseases, such that special effects are difficult to predict. Changes in temperature, moisture and atmospheric gases can fuel growth and generation rates of plants, fungi and insects; there they may amend the interactions between pests, their natural enemies and their hosts (FAO, 2008). Changes in ground cover, such as deforestation or desertification, can make remaining plants and animals ever more vulnerable to pests as well as diseases. For example, foremost shocks faced by rural Households in Singida and Dodoma are death of livestock and crop harvest failure ensuing from drought, floods, crop and pests (Kessy *et al.,* 2011) At the same time as new pests and diseases have frequently emerged throughout history, climate change is now throwing several unknowns into the equation (IPCC, 2007).

Changing climatic conditions could affect both physical and economic availability of certain favourite food items, which might make it impossible to meet some preferences (Schmidhuber & Tubiello, 2007). Changes in availability and relative price changes for

most important food items may result in people either altering their food basket, or spend a greater percentage of their income on food when prices of preferred food items increase. In southern Africa, for instance, many households eat maize as the staple crop, but when there is less rainfall, sorghum fair better, and people consume more of it (Schmidhuber & Tubiello, 2007). Many people prefer maize to sorghum, and therefore, they continue to plant maize besides its poor yields, and would buy maize rather than sorghum, when necessary. The extent to which food preferences change in response to changes in relative prices of grain-fed beef compared with other sources of animal protein will be an important determinant of food security in the medium-term. Increased prices for grain-fed beef are foreseeable, because of increasing competition for land for intensive feed grain production, increasing scarcity of water and rising fuel costs (FAO, 2007).

2.3.5 Farmers Association, Smallholder farmers and Food Security

Farmers in developing countries, mostly working on small scale and family farms have long suffered from inappropriate policies, uncompetitive markets, weak rural infrastructure, inadequate production and financial services, and a deteriorating natural resource base (Penunia, 2011). This has contributed to creating an environment in which farming has frequently been risky and unprofitable for smallholders. Farmers all over the world have tried to address this by organizing themselves into farmers, producers and various self-help groups and associations (Kruijssen *et al.,* 2009). Farmers' Organizations (FOs) emerged in the world due to farmer-felt needs such as sharing of local resources (land, labour, water) and market pressures (prices and access to markets). Other needs are access to services (credit, input supply, and advisory services) or for purely social reasons (social security, food security) (Wennink *et al.,* 2007). Groups have been a type of social capital used by farmers for generations in

Africa (Kristin & Negash, 2005). Farmers' Organizations' (FOs) play a significant role as an institutional vehicle for promoting agricultural development through helping farmers solve common problems in relation to agricultural inputs, credit, technical knowledge and marketing of produce. All these services aim at improving farming activities and enabling them to gain economic benefits to sustain their well-being.

Farmer groups‟ characteristics are shaped by the individual members‟ characteristics since they are formed around a common interest where farmers with similar characteristics are able to come together for a common interest (Asante *et al.,* 2011). In a study conducted on the determinants of small scale farmers‟ decision to join farmers based organizations in Ghana, the results revealed that farm size, farming as a major occupation, access to credit/loan and to machinery services influenced farmers‟ decision to join farmer based organization (Asante *et al.,* 2011). Factors that determine membership to farmer groups in Uganda are education levels of the household head, marital status, age, gender, household size and distance from tarmac road (Adong *et al,*. 2013). Kristin *et al.,* (2010) in a study in Uganda, Tanzania and Kenya found out that younger farmers were more likely to participate in farmer field schools than the older ones. This then shows that individual farmer characteristics determine membership to groups and therefore could influence group characteristics and group performance. In Uganda, farmer groups are targeted as an important means of increasing uptake of agricultural technologies to enhance agricultural productivity, commercialisation and linking farmers to markets (MAAIF, 2010).

The performance of farmer groups depends on a variety of variables which include groups characteristics (group size, composition, leadership), organizational structure (rules and decision making), types of products and markets in which they operate and

the external environment (Markelova *et al.,* 2009). Various group characteristics exist as a result of various factors that influence group formation and the external environment in which the groups operate. Thus there is need to evaluate and document famer groups characteristics to act as a guide when using farmer groups in technology distribution.

One of the channels used by the collaborators to disseminate the crop varieties is through farmer groups as it is a way to reach many in the community (Reyes *et al.,* 2014). Today there is much emphasis on community based mechanisms of distribution in order to bring sustainable change. Group approaches to distribution of innovations is more preferred than farmer to farmer approach since it has helped in strengthening seed systems and tailoring them towards specific agro-ecological and socio-economic environments (Lauren *et al.,* 2007). This facilitates coordination in seed distribution, genetic management, monitoring performance and seed production by the groups.

The groups‟ experiments allow farmers to explore new products with limited risks and expense as well as having more influence in the selection process (Ochieng', 2012). However, it should not always be assumed that groups are the most appropriate vehicles for technology development and distribution since in some cases farmer groups are not always successful thus the need to better understand under what conditions are farmer groups useful and viable (Kiptot, 2007; Markelova *et al.,* 2009).

Njagi (2016) concluded that farmer groups have various characteristics which influenced soybeans seeds distribution. This implies that in use of groups for soybean seeds distribution and other legumes in the future, the identified groups and individual farmer characteristics should be put into consideration. Mwaura (2014) revealed that membership to farmer groups in Uganda is low. Only 16% of household heads belonged

to a group. Although membership to groups resulted in increased yields for banana and cassava, negative impacts were observed for sweet potatoes, beans and maize. Group members were less likely to adopt inorganic fertilisers and improved seed than non-groups members. Msuta and Urassa (2015) showed that FOs contributed positively to their members' well-being. Generally, FO's members had a relatively higher income compared to the non-members, based on t-test analysis; the difference was shown to be statistically significant. Generally, the results indicated that extension services and the use of inorganic fertilizers and pesticides were positively associated with a household's income and assets ownership.

Bulkis *et al.,* (2018) revealed the role of Farmers Groups showed a positive relationship with the level of household food security in Indonesia. So, it is necessary to increase the role of Farmer Group in order to increase income and household food security based on Farmer Group's needs and potencies through facilitation of seed and water/irrigation availability, preparing organization rules (AD/ART) and appropriate training and education of food and nutrition. The study concluded that participation in a farmers' association is positively associated with rural household food security through improved rice and livestock productivity in Indonesia. Survey results suggested that one main role of Farmer associations in Cambodia is to encourage the habit of saving and to provide cash credit to members at better interest rates with a flexible repayment schedule. In addition, Farmers Associations offer opportunities for members to learn about agricultural techniques through training and other extension services provided by supporting agencies (for example NGOs and PDA), which in some cases provide "in-kind" inputs for crops and livestock production. However, all Farmer Association types in the study areas have low capital savings for lending to their members. In West Pokot

County, Farmer Associations fall under the public benefits organizations (PBOs) as illustrated in the county's 2018-2022 CIDP.

2.3.5.1 Membership in farmers Group

Yahya and Xiaohui (2014) found out there are few co-operative groups in the Morogoro, Tanzania, and they also lack proper information about the importance and benefits they can get from their participation in a rural co-operative group. Despite the fact that farmers' participation in a rural co-operative group increases the probability of their household being food secure since it holds much potential for socially and economically poor farmers, few of them do participate. When farmers' access to or participation to rural cooperative groups is restricted, their ability to make their views and opinions known to policy makers and development planners is restricted, which will obviously constrain farmers to carry out their roles in agriculture and food security. Few of farmers were members of the rural cooperative group in Tanzania; most of them were female household heads, more educated and unmarried women. In line with this a study Oxfam International (2013) and Thomas (2006) found that older, wealthier, those received education, and unmarried, female household heads are more likely to be members of agricultural cooperatives as compared to other women.

In an attempt to bridge the gap between men and women farmers in Nigeria, Yemisi and Aisha, (2009) opined that women farmers have joined different groups and have contributed immensely to the advancement recorded by women farmers in their new found voice to aggregate and advocate their needs in national development with particular reference to agriculture development and food production. One such group is the Women Farmers' Advancement Network (WOFAN), a private initiative founded in the early 1990s whose headquarters is in Kano, Nigeria. WOFAN works with 250

women's groups in five different states in northern Nigeria in an effort to mobilize and train rural women in the management of information and communication. According to Afolabi (2008) on role of women in household economy, food production and food security: focusing on the activities of rural women in Ondo State of Nigeria made a careful analytical study of women's agricultural activities and discovered that they are very strong pillars of the economy in the state. Women in the state are organized into groups, which are often engaged in more than one economic activity.

The study by Franklin (2007) in nine countries in Africa, found that while women are present in greater degrees in agricultural/rural organizations, they tend to comprise a low proportion of the membership and are often not represented in the higher levels of leadership. While women's membership is most often limited by their lack of formal land ownership, many rural organizations do not sufficiently concern themselves with the needs of rural women. Women's participation as office holders in these organizations tends to be even more limited. The most striking example is in Zimbabwe, where despite the fact that women constitute 75% of the members in the Zimbabwe Farmers Unions, only 5% of the officials are women.

However, the largest numbers of women decision makers are found in the Sudan, where 14% of the office holders in agricultural cooperatives are graduate women. In Africa, few women hold policy-making positions at the national level and those that do tend to be concentrated in social ministries such as education, health and women affairs. Only rarely do women hold such positions in technical ministries such as agriculture, which has far-reaching implications for the policies generated there. Overall, women hold an extremely low number of decision- making positions in the ministries dealing with agriculture and rural development.

2.3.5.2 Role of Farmer Associations

During the past years, farmers' association have rendered a variety of services both to the farmers and to the government. Although their role may have varied with the emphasis of development, they have been an essential instrument for carrying out various rural reconstruction programmes. The following is a brief description of the major functions that the farmers' association have performed to enhance food security.

Assisting government to work out agricultural development plans: Agricultural experience in the developed countries indicate that no development plan can be effectively carried out without the active participation of the local people. It is also noted that the local people cannot fully participate unless they are sufficiently organized and trained to put forth a united effort. With a three-tiered organization to correspond with the levels of civil administration, the farmers' association acts as a channel to make government plans and policies known to all the farmers. By the same token, the farmers can express their views about government plans or make their problems known to the government. This two-way communication system has helped make government agricultural plans meet the felt needs of the farmers. Farmers' associations handle other government entrusted services such as the distribution of fertilizer, the collection of farm produce and other farm products from the farmers and the processing of these products for the government.

Facilitating agricultural extension: Newly developed agricultural practices and expertise must be diffused and put to use in actual farming operations. This is usually done by means of the agricultural extension system, which serves as a bridge between agricultural research at the experimental stations and adoption of new farming techniques at the farm level. One of the major services that a farmers' association

performs is farm extension. Among all the farm extension activities the farm discussion groups have been the most successful, influential and unique in several respects. A farm discussion group is composed of approximately twenty farmers. It should also be mentioned that the agricultural extension service performed by the farmers' associations is closely co-ordinated with other activities of the associations and other agencies concerned.

Providing supply and marketing services: In the process of agricultural development, it is essential to provide farmers with adequate inputs of production and convenient outlets for their outputs. According to Huang et al, (2009) farmers' associations in Taiwan have also played an active role in these respects. In the supply business, the distribution of chemical fertilizer has been most important. To meet the needs for crop and livestock production, the farmers' associations have made considerable efforts to develop self-initiated purchasing and supply services during recent years. The supply of feedstuffs, pesticides, seeds, breeding stocks, farm implements, etc. has increased year by year. The marketing service is to eliminate the undue profiteering by middlemen. As the agricultural industry has become more commercialized in recent years, the role of the farmers' associations in the marketing of farm products has become more important.

Supplying farm credit: Modern farm inputs mean to some extent higher production costs for the farmers, which in turn become a heavier financial burden. To relieve this financial constraint, farm credit is needed. The loans extended by farmers' associations are more effective and compatible with the farmers' needs because extension services often go along with them. Most of the loans extended are for production purposes. The lending funds of the farmers' associations come mainly from the savings deposits of

their members. Borrowings from the government and banks make up the seasonal shortage. The farmers' associations are generally recognized as very effective in financing agricultural production. Because they have an intimate knowledge of the farmers' needs and are capable of linking the farmers' borrowings with extension services, they are in a position to render credit service directly to the farmers. Since farmers usually feel more at ease discussing their financial problems with staff members of the farmers' association than with bankers, some of the loans provided by the government and banks are also channelled through the farmers' associations. This has contributed greatly to the successful implementation of agricultural development programmes.

In the quest of achieving of household food security in West Pokot County, smallholder farmers in West Pokot County need to be involved in farmer associations and hence the need to study the influence of farmer association on the relationship between smallholding farming and household food security in West Pokot County.

2.4 Smallholder Farmers under Different Perspectives

Smallholder farmers make essential contributions to the agricultural and rural economies in all developing countries. Their roles vary considerably between and within regions and are changing rapidly in many parts of the world, where economic and social forces are transforming the agricultural sector. Rural farmers often manage complex households and pursue multiple livelihood strategies. Their activities typically include producing agricultural crops, tending animals, processing and preparing food, working for wages in agricultural or other rural enterprises, collecting fuel and water, engaging in trade and marketing, caring for family members and maintaining their

homes. Many of these activities are not defined as “economically active employment” in national accounts but they are essential to the well-being of rural households.

There is no universally accepted definition of a small farm. ‘Small’ may refer to the number of workers; capital invested, or amount of land worked. Land size is the criterion most commonly employed, but given the differing potential of land in soil quality and rainfall, a single measurement hardly captures the sense of limited resources or relative powerlessness characteristic of smallholders. Overall, smallholder farmers are characterized by marginalization, in terms of accessibility, resources, information, technology, capital and assets, but there is great variation in the degree to which each of these applies (Odoemenem & Obinne, 2010).

With these qualifications, the Food and Agriculture Organization of the United Nations (FAO) adopted a 2-hectare (ha) threshold as a broad measure of a small farm (which is not inclusive of fishers and other small-scale food producers). The vast majority of smallholders live in rural areas, although urban and peri-urban smallholdings are an increasingly important source of supply for developing urban areas (IFAD, 2011). Smallholders include some 350 million indigenous peoples, who conserve many different crop varieties and livestock breeds. Their agricultural practices and techniques offer an important source of knowledge for the transition to sustainable agricultural intensification.

2.4.1 Smallholder Farmers in Global Perspective

Globally smallholder farmers consist of women to a large percentage (IFAD, 2011). Smallholder farmer’s contribution to agricultural production varies from country to country, crop to crop and task to task. For instance according to Sidh and Basu, (2011), Latin American women are less involved in crop production than women in sub-

Saharan Africa, but are largely responsible for small livestock. In Southeast Asia, women provide up to 90 per cent of the labour for rice cultivation. In Colombia and Peru, women perform 25 to 45 per cent of agricultural field tasks. Men are found more often in agricultural wage labour and cash crop production, while women are mostly found producing food for their families and local markets. Women are also found in agricultural wage labour. In Northwest Brazil, for example, women make up 65 per cent of the field workers in vineyards. In Chile, women comprise 60 per cent of the contractual workers in the fruit sector. In Sinaloa, Mexico, women are 40 per cent of the field workers for vegetables and 90 per cent of the packers. This shows that there is a gender dimension to smallholder farmers in different continents.

In Sri Lanka, the role that women play regarding household food security would not be much different from many other developing countries especially, within the cultural context of Sri Lanka, women are pre-dominantly assigned the role of food preparation and food management within the household (Kalansooriya &Chandrakumara, 2015). The study found that rural households fulfil a majority of their food needs (staples) from their own cultivation, although the home growing food crops did not increase the diversity of the diet consumed. More importantly, a large part of the responsibility of home growing food crops is taken up by women in households. Other than the contribution to the growing of food crops, women's involvement in making food available in the household could be seen from their effort in maintaining food stocks in the household. In a majority of households women were the main responsible persons in keeping food available in households, and it was found that they took the advantage of their indigenous knowledge in doing so.

2.4.2 Smallholder Farmers in Regional Perspective

Smallholder farmers are the key actors in Ghana's agriculture, constituting over half the agricultural labour force and producing 70 per cent of the country's food stock. Women constitute 95 per cent of those involved in agro processing and 85 per cent of those in food distribution while the males take up the rest of the percentages. Their contribution to agricultural work varies even more widely depending on the specific crop under cultivation, type of involvement and activity. Due to the specific role of smallholder farmers in food production, many of them are repositories of knowledge on cultivation, processing, and preservation of nutritious and locally adapted crop varieties. It is estimated that if farmers had the same access to productive resources, they could increase yields on their farms by 20 to 30 percent, and this could raise total agricultural output in Ghana by 4 percent, which in turn could reduce hunger by 17 percent. In the long run, this would improve family nutrition, food security (Jost *et al.,* 2016).

Appropriately one third of South African households are involved in small-scale farming but agriculture does not contribute more than 4 percent to their total incomes even though farming requires very high time commitments from family members. Oni *et al.,* (2010) revealed that most women smallholder farmers in the Thulamela local municipality of the Vhembe District have failed to achieve food security in spite of considerable investment in agriculture by the South African government. Many of the programmes failed before they even took off due to some socio-economic constraints.

Ibnouf (2009) indicated that smallholder farmers in rural Sudan play a crucial role in improving their household food security, as they contribute to food production, enhance dietary quality and consumption diversity. The study implied that in most rural areas in Sudan women are more capable than men in terms of the ability to use and allocate the

available resources for the purpose to improve food security for their families. Tegegne (2012) found that few supporting organizations to smallholder farmers in agricultural activities. Some of the organizations had not performed (delivered) adequately in providing the needed services in terms of credit and facilities. The role of NGO in the district resulted in the limited development of innovative, participatory and replicable models of development, which has been reflected in their limited role in appropriate agricultural technology, particularly for women.

2.4.3 Smallholder Farmers in Local Perspective

Ombese (2016) found that most smallholder farmers participating in food security projects in Kiambaa Constituency, Kiambu County apply ideas that they learn about farming activities. Smallholder subsistence farmers, especially women, are responsible for food security projects. The study found that women's ability to access agricultural information is key to food security. Agricultural information not only endows one with the power to read and hence be informed, but it also allows one to farm in an effective way. The study further found that women land ownership influence food security since women use land fully for subsistence farming. Subsistence farming mainly provides families‟ staple food and in the case of extra supply it could be sold to cover for household expenses.

Ogoti (2014) found that in Nyamira County, resources necessary for household food production, mainly land, oxen and plough, and farm equipment and implements were controlled by the husband or the father in- law, two, the household income was also controlled by the husband, three, the woman did not participate in decision making on household food security. Another finding was that the woman was the major labour provider for household food security. Therefore, woman should have control of the

necessary resources like land and equipment to facilitate food security in the households. The woman should access and control the household income so as to provide for adequate food for the household members. She should also participate in decision making issues in food security issues in the household. The husband should provide the much needed labour in the production, harvest, preparation, preservation and storage of food in the household to ensure household food security.

Liru (2014) indicated smallholder farmers in Malava constituency actively contribute to food security in their households and have developed coping strategies to ensure their families are food secured. Although smallholder farmers in Malava are disproportionately responsible for providing food to their families both in female-and male-headed households they are faced with a number of constrains. They have less access to, and control of, agricultural assets and inputs than men. In addition to discrimination in gender difference in observable characteristics, there are other forms of discrimination in terms of accessing different services such as extension and education and unobservable gender difference in characteristics including ability and motivation.

Buluku (2013) indicated that gender imbalances are rampant in Mt Elgon district. Very few women and the youth own land and other resources that are crucial for production purposes. Access to factors of production such as credit is curtailed since men own land which is the main factor of production. Women account for 50% of the total population while the youth account for 28.8%, low participation in decision making and access to productive resources are the main challenges facing the youth in the district. Women had more access to agricultural resources but male had control and decision making authority on the resources in Mt. Elgon District, Bungoma County. Control over

resources positively influence productivity and women who had access to resources showing to be more effective in productivity as compared to male. The study also found that women had more access to credit as compared to men due to the fact that women were more involved in VSLAs that advance credit to members

2.5 Summary of Literature and Research Gaps

It can be identified that the existing literature that reviews food security mostly analyses the macro level (national) food security, and concentrates on analyzing food availability with little or no attention to food security. There are few micro level studies which analyze household level food consumption, and very few of those have been designed to investigate the smallholder farmers' contribution. However, those studies concentrate on either calorie consumption measures which interrelated with poverty line definitions (Rathnayake & Weerahewa, 2003) or on anthropometry measures (Ekanayake et al., 2003; Gunesekara, 1999). On the other hand, those studies had not taken into account the smallholder farmer's influence in all four dimensions of food security although they examine role of smallholder farming. The issue of climate change especially is ASAL regions have also been identified as key factor in influencing smallholder farmers toward food security. However, there is dearth of studies of this nature which seek to examine if farmers associations have a significant influence on the smallholder farming contribution to food security. Accordingly, this study attempted to solve the problem that whether the smallholder farmers play a significant influence of assuring household food security in West Pokot, Kenya in the rural context.

2.6 Conceptual Framework

A conceptual frame work is defined as a set of broad ideas and principles taken from relevant fields of enquiry and used to structure a subsequent presentation (Kombo &Tromp, 2009). A conceptual framework refers to a research tool intended to assist a researcher to develop awareness and understanding of the situation under scrutiny and to communicate it. It is a diagram that visually shows the relationship between the independent and dependent variable of the study. This study was guided by the following conceptual framework in Figure 2.1

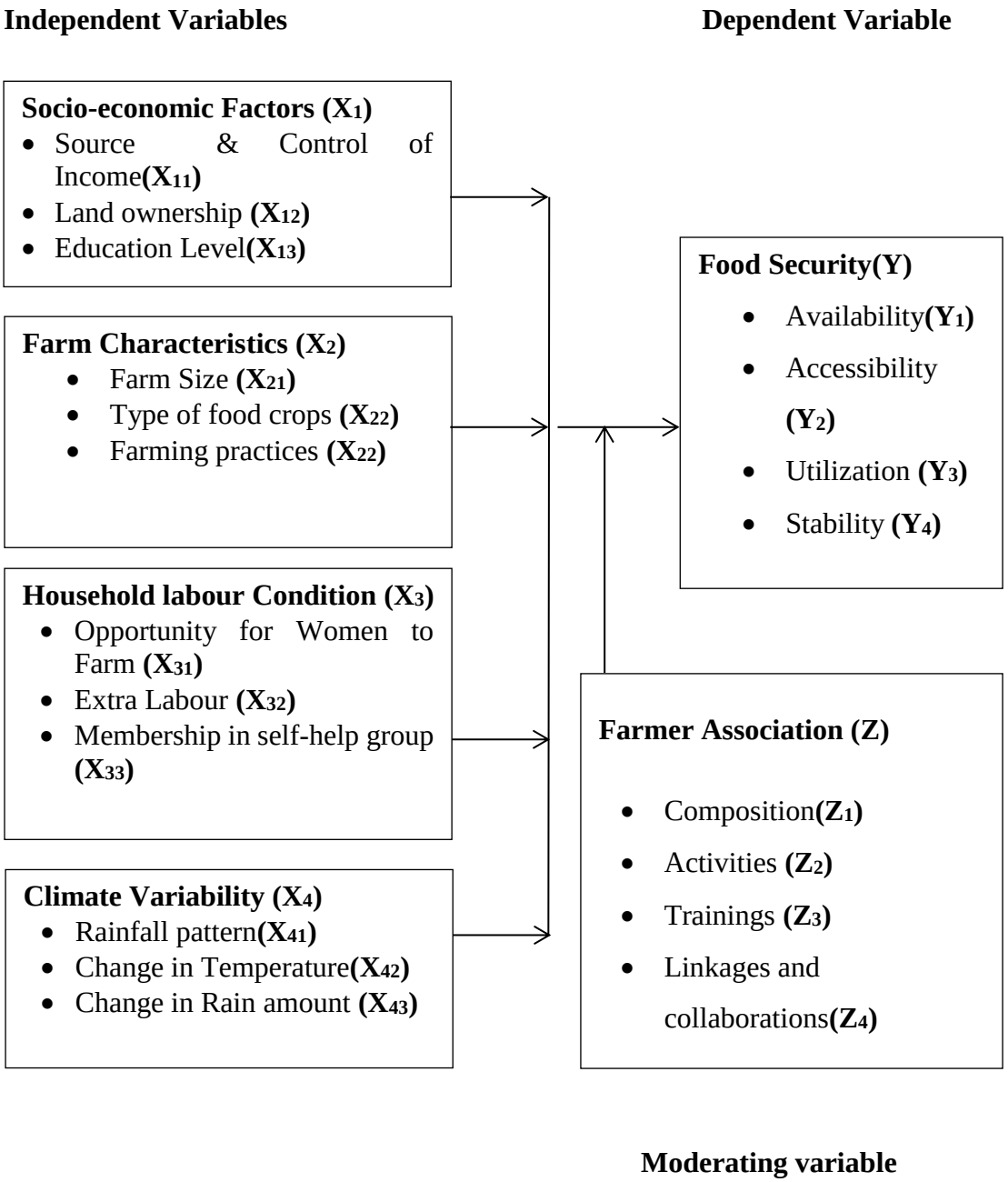

Figure 2.1: Conceptual Framework

According to the above conceptual framework, contribution of smallholder farmers toward food security is conceptualized in terms of smallholder farmers' socio-economic characteristics, smallholder farming characteristics and smallholder farmers' labor condition as independent variables. The dependent variable which is food security was measured in terms of food availability, accessibility, utilization and stability. It is important to note that farmer association was used as moderating variable on the

premise that it had an influence on the relationship between smallholder farming and food security.

Farmer association as a moderating variable in this study was conceptualized in terms of the composition of the association, the kind of activities it holds, the trainings they have for the members and any linkages and collaborations the association has. Literature indicates that, Farmers' Organizations (FOs) emerged in the world due to farmer-felt needs such as sharing of local resources (land, labour, water) and market pressures (prices and access to markets). Other needs are access to services (credit, input supply, and advisory services) or for purely social reasons (social security, food security) (Wennink *et al.*, 2007). Farmer associations largely play a significant role as an institutional vehicle for promoting agricultural development through helping farmers solve common problems in relation to agricultural inputs, credit, technical knowledge and marketing of produce. All these services aim at improving farming activities and enabling them to gain economic benefits to sustain their well-being.

The socio-economic construct is more aligned to entitlement theory as it uses land ownership as an entitlement factor as part of its measurements. The Household labour conditions as a motivator is more aligned to the Basic Needs Approach while climate variability affects the farming system and is thus more aligned to the Farming Systems Approach.

CHAPTER THREE

METHODOLOGY

3.1 Overview

This research study employed a convergent research design. This study also used a mixed method research approach to collect both quantitative and qualitative data.

3.2 Philosophical World Views

The philosophical approach of this study was underpinned by the pragmatic approach. This approach relies on version of adductive reasoning that moves back and forth between induction and deduction by first converting observations into theories and then assessing those theories through action. The interaction between knowledge generated under qualitative and quantitative research approaches enriches the choice of mixed methods used in this study (Morgan, 2007).

Pragmatism was suitable for this research approach because it is not fixed to any one system since it draws freely from both qualitative and quantitative assumptions. Pragmatists agree that research occurs in social, historical, political and other contexts as will be seen in the scope of this study (Creswell, 2003). Also, pragmatism allowed the researcher the freedom to choose from the approaches, techniques and procedures that will be applied in the study. Through pluralistic approach, it was possible to use several approaches for data collection and analysis. However, the researcher acknowledges the fact that different approaches to a research can only be validly combined when the logical combination between each approach has been established and that the criteria used to evaluate the research has been made clear. On this basis then, the strengths of one approach compensated the limitations of the other (Flick, 2002).

3.3 Research Design

Kerlinger (2011) notes that research design is the planning of conditions from collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure. This study adopted convergent research design. According to Creswell (2012), in convergent research design the researcher collects qualitative and quantitative data concurrently. The data collected usually has an equal value for understanding the research problem.

This study adopted the design to establish the relationship between smallholder farming and food security in West Pokot County. The selection of variables allowed the design to use both quantitative and qualitative techniques to establish relationship among them. The application of mixed methods in the study entailed embracing the procedures that guide its use by emphasizing the importance of timing, weighting and mixing as discussed below (Clark & Creswell, 2007).

3.3.1 Timing

Timing is about when data was collected. The researcher collected qualitative and quantitative data simultaneously. However, this depended to some point on the availability of respondents during the study. The researcher conducted a separate analysis of data collected in order to maintain clarity of the results obtained. The simultaneous collection of data is in conformity to the tenets of convergent research design that is concerned with treating both quantitative and qualitative data equally (Clark & Creswell, 2007).

3.3.2 Weighting

This concerns the relative importance given to different approaches that will be applied by the researcher in the study. This study embraced mixed method as a dominant

approach and for this reason quantitative data was given the same weight as qualitative data considering that the researcher's epistemological view was pragmatic. Consequently, quantitative data was collected using reliable techniques same with the qualitative data and both were integrated during analysis to offer a full picture of the phenomenon under study.

3.3.3 Mixing

The researcher mixed data at collection in the field, during analysis and interpretation stages of the study or at all the three stages. This view is also held by Saunders *et al.*, (2009) that data can be merged by embedding one data type on another, transforming and integrating two different data types together or the can be presented separately and the connected to test a particular hypothesis.

3.4 Research Approach

Research problems today, require a more comprehensive and nuanced efforts (Gay & Weaver, 2011). Because of this, the researcher adopted a mixed methods approach because it provided the researcher with more choices and options to consider on how to collect data for this study. Also, the study exploited the bridge that the approach provides to enrich the quality of any study by drawing from the strengths and minimizes the weaknesses if only one approach was used. Hence it helped in the triangulation of the findings.

The study embraced mixed methods because mixing qualitative and quantitative data during collection and analysis provided deeper insights and a more complete picture of the phenomenon and triangulated research yielded results that were more comprehensive and reliable than those generated through single methods (Creswell & Plano Clark, 2017). This approach also helped in triangulation of the research findings.

In order to bring more clarity and understanding, complementarities helped the researcher to enhance results with the second source of data while abductive inspiration was particularly useful during piloting the study since this would enable the researcher generate the ideas that shaped the study. Mixed methods provided a framework for answering different questions that cannot be exclusively be answered by either qualitative or quantitative approaches, and also it provided a greater repertoire of tools to meet the objectives of the study. Through initiation it was possible to develop new perspectives of phenomena under study and stimulate further research at the end of this study.

Further, mixed methods allowed for offsetting weaknesses and providing stronger inferences of each approach while strengths were built upon, thus provided stronger and more accurate inferences of research findings (Bryman, 2006; Creswell &Clark, 2007).

3.5 Study Area

West Pokot County is an Arid and Semi-arid area located in the Rift Valley Province. It borders Uganda to the west, the counties of Trans-Nzoia and Marakwet to the south and the county of Turkana to the north and east. The county covers a surface area of 9169.4 Km^2 and includes seven geographical divisions: Chepareria, Kacheliba, Kapenguria, Kongelai, Mnagei, Sook and Tapach. The traditional lifestyle in the area has been pastoralism, but through rapid cultural, institutional and land use transition this is now changing to sedentary agro pastoralism. Within West Pokot there is also considerable variation–from the dry land, predominantly pastoralist division of Kacheliba in the north-western part of West Pokot, through the divisions of Kongelai and Chepararia, where communal land is increasingly being enclosed for intensified,

livestock-based agro pastoralist production; to the crop-based, agro pastoralist division of Kapenguria, with more rainfall at higher altitude in the south. The other divisions are situated in water-scarce and partly in severely-eroded lowland areas with instances of frequent overgrazing and increased population which have led to a need for intensified and more productive land-use, including growing crops and trees.

In 1999, the county had a total population of 308,048 people while in 2009, the population was 512,690 representing an inter censual growth rate of 5.2 per cent per annum. This huge increase of the population has exerted more pressure on social amenities especially health services, education and worsen food insecurity. This high population growth rate poses a big challenge and is heavily contributing to the high unemployment rate in the county. Majority of the population in the county depend on natural resources to derive their livelihoods. Consequently, protection of the environment is paramount. The County faces environmental challenges which include loss of natural biodiversity, degradation of forest resources, forest fires, soil erosion as a result of overgrazing and de-vegetation, frequent drought, water and land pollution as a result of poor waste management. Soil erosion is mainly attributed to poor farming methods. The main cause of deforestation is encroachment and clearing for cultivation, demand for timber and fuel wood.

The main crops produced include maize, finger millet, potatoes, beans, onions sweet potatoes, green grams, peas, mangoes, oranges, bananas, coffee and pyrethrum. Maize is the staple food in the County and is mainly grown in West Pokot Sub-County. Potatoes and pyrethrum are grown in South Pokot Sub-County. These food crops produced do not meet the food requirements of the county. The total acreage under food crops and cash crops is 22,000 ha. This consists of 17,000 ha under food crops and

5,000 ha under cash crops. Acreage under food crops continue to increase due to irrigation schemes such as the Weiwei irrigation scheme in Sigor. The traditional zebu is the main breed in Pokot Central and North Sub-Counties for meat production while West Pokot and Pokot South Sub-Counties keep improved dairy cows such as Ayrshire and Friesian. There are 686,375 indigenous Zebu cattle, 460,327 sheep, 551,596 goats, 30,617 camels, 36,473 donkeys and 397 pigs. The annual production of beef stands at 3.6 million kg valued at Ksh.653 million while annual milk production is 4.7 million litres valued at Ksh.134 million. The livestock subsector has huge potential for generating household income and revenue for the county.

The county is within arid and semi-arid region and therefore experiences frequent drought which has led to recurrent food insecurity. The county food poverty stands at 69.7 per cent (County CIDP, 12-17). This shows that majority of the population cannot afford the minimum basic nutritional requirements. The farming methods have remained traditional over a long time, exemplified in dependence on rain fed agriculture, shift cultivation, cultivation along sloppy areas, mono-cropping and non-mechanized farming. Food insecurity continues to hinder other development investments both by the government and at individual level. Resources are usually shifted to solving short term food insecurity problem in the county rather than tangible investments. There is however a huge potential for irrigation farming that could make the county food sufficient.

3.6 Target Population

This study was carried out in West Pokot County which is the geographical location of the area under study (Neuman, 2006). The target population in this study was 78,946 households in West Pokot County (KNBS, 2013). These households were clustered into

sub counties. This included: West Pokot Sub County which has26,660 household, Pokot Cental-14,840 households, North Pokot 15,338 households and Pokot south has 22,108 households. The distribution is as shown in Table 3.1.

West Pokot County was selected because unlike other areas in the region (Turkana and Baringo), the county has witnessed significant shifts in smallholder position and shifts in agro-pastoral zone development and management. Basically, West Pokot County is classified in the Crisis (Integrated Food Security Phase 3) due to low food security indicators such as food availability, food accessibility, food utilization and food stability (SMART Survey, 2017).

Table 3.1: Target Population

Sub County	No. of Households
West Pokot	26,660
Pokot Central	14,840
North Pokot	15,338
Pokot south	22,108
Total	**78,946**

Source: KNBS (2019)

3.7 Sample Size and Sampling Procedure

Sample size has an effect on how the sample findings accurately represent the population. The larger the sample is, the more likely that the generalizations are an accurate reflection of the population (Saunders, Lewis & Thornhill, 2007). For purposes of generalization, it will be essential that the sample size is appropriate, such that the results are representative, and that the statistics can show associations or differences within the results obtained from the study (Fox, 2007). The formula used is as shown below:

Sample size n = [(z^2 * p * q) + ME^2] / [ME^2 + z^2 * p * q / N]

n =sample size, z =critical standard score, p = population proportion, q = 1- p, *ME* = margin of error, N =size of the population

n = [($(1.96)^2$ * 0.90 * 0.10) + $(0.035)^2$] / [$(0.035)^2$ + $(1.96)^2$ * 0.90 * 0.10 / 78,946] = 282.2309954 which is **282** households

Study sites were selected with regard to the land classification types in West Pokot largely based on food (crop) production potential. According to Obwocha (2015), the Pokot themselves utilize their land largely on the basis of altitude, rainfall and agricultural potential. As noted by the same author, the Pokot have classified their land into three zones. Briefly, he analyses the three zones as follows: The *Masop*, or high mountain tops, which receive most of the rain and are heavily forested, the *Kamas*, or steep mountain slopes, and the *Tow*, or flat valley land. Thus, food production in the area corresponds more or less to altitude, soils and climatic conditions.

In this regard, the study classified its interest on high potential zones which are all area in the highlands and corresponds with *Masop*. This area receives the highest amount of precipitation per annum. Most of West Pokot sub county areas fall in this category. Medium potential was defined by areas adjacent to the highlands and corresponds with *Kamas.* Most of South Pokot sub county areas fall in this category. Finally, low potential i.e. area far away from the highland and is mostly arid and corresponds with Tow. Most of North Pokot sub county areas fall in this category

First, West Pokot County was purposively sampled based on the geographical location, diversity in agro ecological zones and proneness to food insecurity. A list of administrative sub counties in the three land classification types were considered from

which one sub county was selected using non-probability random sampling as a representative whereby West Pokot Sub County, South Pokot and North Pokot County was selected. From the randomly selected sub counties, the division within the sub county was listed and purposively categorised on the basis of the land classification in the area, climatic conditions experienced in the specific locations and accessibility/security whereby one division per Sub County was selected and Kapenguria, Chepareria and Kacheliba was sampled. Further from each division, two locations were randomly sampled to bring the total number of locations to 6. From each location, two sub locations were randomly sampled bring the total number of sub location to be twelve. From each sub location, the study sampled two villages making the total number of villages in this study to be 24. From each village, the study selected between 11 and 12 households using systematic random sampling where each 2ndhousehold was sampled to achieve a sample size of 282.

The local administration leaders that included chiefs and village elders helped the researcher to identify farmers and make the necessary appointments. The study also used Key informants comprising of 6 chiefs and 6 agricultural extension officers for both livestock and crop production each from the 6 locations and 3 representatives of Non-Governmental Organizations working on Food security in the study area. Therefore the total sample size was 297 respondents as shown in Table 3.2.

Table 3.2: Sample Size

Division	No. of Locations	No. of Sub Locations	No. of Villages	No. of Households
Kapenguria	2	4	8	117
Kacheliba	2	4	8	67
Chepareria	2	4	8	98
Total	**6**	**12**	**24**	**282**

Researcher (2019)

3.8 Methods of Data Collection

A Questionnaire and interview guides were used in data collection. Orodho (2005) observes that questionnaires have a major advantage of time efficiency and anonymity. Creswell (2014) argues that the questionnaire is a suitable tool for collecting data given a large sample size. Based on these advantages, the current study preferred to use the questionnaire and interview guide for key informants over other tools of data collection. In this study, questionnaires were used to collect data from smallholder farmers. On the other hand, an interview guide was used to solicit for in-depth data from key informants and farmers' organizations in the county. These instruments were used to collect primary data. The description of each data collection instrument is described below:

3.8.1 Questionnaire

The questionnaire was used collect data from sampled smallholder farmers. The questionnaire was preferred because it is an appropriate tool through which many respondents can be reached. The questionnaire made it possible for the researcher to obtain a wide variety of responses and draw more reliable conclusions from the responses of members of the county departments. It facilitated easy and quick derivation of information within a short time. In this study both open and close ended questions were used. The questionnaire was divided into sections (A up to G). Section

A sought for background information from respondents. The other sections contained items on smallholder farmers' contribution to food security. There was a section that assessed the household food insecurity using an indicator called the Coping Strategy Index (CSI). The CSI is based on a list of behaviours (coping strategies). It combined; (i) The frequency of each strategy (ii) Their severity for households reporting food consumption problems. Higher CSI indicated a worse food security situation in a household. The researcher administered the questionnaires with the help of four research assistants to the respondents and thereafter the complete questionnaires were collected immediately for data analysis.

3.8.2 Interview for Key Informants

It was used to solicit for qualitative data from the key informants sampled from National and county government officials. According to Ogula (2008), an interview guide gives the researcher an advantage to seek clarification on issues not made clear and also pursue to get insights and elaboration about the problem under investigation. It is against this background that this instrument was preferred in the study. The key informants included: 6 chiefs and 6 agricultural extension officers for both livestock and crop production and 3 representatives of Non-Governmental Organizations working on Food security in the study area.

3.8.3 Observation

Observation is a way of gathering data by watching behaviour, events, or noting physical characteristics in their natural setting (Taylor and Steele, 1996). The advantage of observation is that it can be used when you are gathering data on individual behaviours or interactions between people or when you need to know about a physical setting or even when data collection from individuals is not a realistic option.

Observation schedule can be expensive and time-consuming compared to other data collection method and susceptible to observer bias. The researcher was a keen observer during the period of data collection exercise guided by the observation schedule check list. The items that were to be observed were labour division and farming activities undertaken by smallholder farmers.

3.9 Piloting of Research Instruments

The researcher administered a set of structured questionnaires through a pilot study in Bartum Sub location in Baringo-North Sub-County which has similar characteristics to West Pokot County. The pilot study was used to appraise the questionnaire soundness of the items, estimate time required to answer the items and confirm viability of the research topic. The pilot study utilized 29 (10%) respondents that were not covered in the study's sample population. The results of the pilot study were discussed with the respondents and supervisors to make the required adjustments in the instrument. The major objective of piloting was to test the instruments' reliability and validity discussed below.

3.10 Validity and Reliability

Validity and reliability are closely related terms which have been defined differently by different authors in different contexts. Validity and reliability are usually complementary concepts, although reliability seems easier to achieve if the measure is precise and observable (Neuman, 2006). Thus, validity and reliability are necessary to get distinctive results.

3.10.1 Validity

Makombe (2006) defines validity as the correctness of a description, explanation, interpretation, account or conclusion. In the same work (Makombe, 2006; Ballinger, 2000) posits that validity refers to whether the variables measure what they are intended to measure. It is concerned with whether the findings are really about what they appear to be (Saunders *et. al.,* 2009). Validity and reliability are usually complementary concepts, although reliability seems easier to achieve if the measure is precise and observable (Neuman, 2006).

Vau in Ballinger, (2000) distinguishes three types of validity namely criterion, content and construct validity discussed below. Furthermore, the study needs to be both internally and externally valid to allow for generalizations (McClung, 1988). Internal Validity refers to the extent to which the research design and the data that it yields allows the researcher to draw accurate conclusions (Leedy & Ormrod, 2005). To ensure internal validity triangulation of the methods of data collection is recommended (Leedy & Ormrod, 2005; Silverman, 2005). In this study triangulation of data collection methods (questionnaires and content analysis) was applied.

External Validity on the other hand means the extent to which the results of the study can be generalized (Silverman 2005; Saunders *et. al.,* 2009). Use of real life settings, a large sample and probability sampling procedures used in this study enhanced representativeness of the sample improving external validity (Leedy & Ormrod, 2005).The validity of the data collection instruments that were used to collect data were measured by deriving all the questions from the study's objectives, and checking each question to determine its contribution to the objectives (Check & Schutt, 2012). As suggested by Throckmorton (2009), content validity of the instrument is assured by a

Meta analytic comparison with earlier studies using similar designs and favourable observations from experts (supervisors) reviews, whose results showed content convergence.

3.10.2 Reliability

Reliability refers to the dependability or consistency of the research results (Neuman, 2006). It is the degree to which the same results would be obtained in repeated attempts of the same test (Gall & Gall in Ballinger, 2000; Silverman, 2005). Put differently, it is the stability of the measurements obtained from the variables (Ott& Larson in Ballinger, 2000). Authors Easterby-Smith *et al.,* (2008) add that it is the extent to which data collection techniques and analysis procedures yield consistent findings.

To test internal consistency of the items listed on the instrument used, the Cronbach alpha coefficient was computed. The statistic coefficient value between 0 and 1 was used to rate the reliability of an instrument such as a questionnaire ranges. The statistic coefficient value splits the data randomly into two sets and a score for each participant calculated from each half of the scale. If a scale is very reliable, respondents get same scores on either half of the scale so that, correlation of the two halves is very high (Cronbach, 1951).The advantage of Cronbach's alpha is that data is split into every possible way and the correlation coefficient for each split computed. The average of these coefficients is the value equivalent to this alpha (Cronbach, 1951). A total of twenty nine respondents were used in the pilot study to obtain data for testing reliability.

3.11 Framework for Data Analysis

To allow observation and data collection, smallholder farmers were interviewed in their houses or business premises (farms). The local administration heads that included chiefs and village elders helped the researcher to identify farmers and make the

necessary appointments. The study employed both qualitative and quantitative analysis. Qualitative analysis is defined as the use of qualitative data such as perceptions and knowledge in relation to the phenomenon under investigation. On qualitative approach, the study employed descriptive analysis. The main feeder to qualitative information was key informant interviews and observations.

3.11.1 Data Processing and Analysis

The study used both quantitative and qualitative data analysis. The data that was obtained through questionnaires was edited and coded through a predetermined coding scheme. Editing of data is a process of examining the raw data (especially in surveys) to detect errors and omissions and to correct these errors where possible (Kothari, 2004). It entails careful scrutiny of the completed questionnaires to assure that the data are accurate, consistent with other facts gathered, uniformly entered, as complete as possible and have been well arranged to facilitate coding and tabulation (Kothari, 2004). Data editing for this study was done at two stages, in the field and central editing. Field editing consisted of the review of the reporting forms by the investigator for completing (translating or rewriting) what the respondent had written in abbreviated and/or in illegible form at the time of recording the responses.

Coding is the process of assigning numerals or other symbols to answers so that responses can be put into a limited number of categories or classes to attain computational simplicity (Nassiuma, 2017). Coding was necessary for efficient analysis as it helped reduce several replies to a small number of critical classes of information needed for analysis. The advantage of coding data is that it makes data manageable (Nassiuma, 2017; Neuman, 2006).The Codes were included in the

questionnaire as pre-set codes for variables with limited categories enabling coding at the data collection stage.

3.11.2 Quantitative Analysis

The quantitative aspect of the study employed a structured questionnaire to collect data. Quantitative data was analysed in SPSS and at descriptive level and more soundly statistics of empirical facts. This involved derivation of statistical descriptions and interpretation of data by use of descriptive statistics that mainly rely on numerical values. Quantitative data was coded and with the use of SPSS computer program, the statistical summaries were derived and presented in the form of frequency tables, percentages, cross-tabulations, means and standard deviations.

Inferential statistics were used to determine the relationships between smallholder farming, farmers associations and household food security as well as testing the hypotheses. Correlation analysis by means of Pearson Product Moment Correlation Coefficient technique was used to determine nature and magnitude of the relationships p between smallholder farming, farming association and household food security.

Correlation coefficients ranging from 0.00 to 0.01 represent no correlation, those ranging from 0.02-0.029 represented weak correlation, 0.30-0.69 represented moderate correlation, and 0.70-0.89 represented strong correlation while 0.90-0.98 represented very strong correlations (Rummel, 1970). Coefficient of determination (R^2) was also used to determine the goodness of fit of different models by indicating whether the proportion of household food security explained by all the combined predictor variables was equal, greater than or less than the population of each predictor variable.

The closer r^2 is to 1, the better the fit of the regression line to data. As the study consisted of a combination of independent, moderating and dependent variable, the effects of the

variables was tested using different regression analysis models H_{01}, H_{02}, H_{03} and H_{04} was tested using simple linear regression analysis. H_{05} focused on determining the joint effect of independent and moderating variable and was tested using multiple linear regression and hierarchical regression analyses. The Hypotheses were modelled as described below:

H_{01}: There is no significant relationship between smallholder farmer's socio-economic factors and household food security in West Pokot County. $H_{01}$was modeled as:

$$Y_1 = \alpha + \beta_1 X_1 + \varepsilon$$

H_{02}: ***There is no significant relationship between smallholder farming characteristics and household food security in West Pokot County*** H_{02}wasmodeled as:

$$Y_1 = \alpha + \beta_2 X_2 + \varepsilon$$

H_{03}: ***There is no significant relationship between smallholder farmer's household labor condition and household food security in West Pokot County*** $H_{03}$was modeled as:

$$Y_1 = \alpha + \beta_3 X_3 + \varepsilon$$

H_{04}: ***There is no significant relationship between climate variability and household food security in West Pokot County*** $H_{04}$was modeled as:

$$Y_1 = \alpha + \beta_4 X_4 + \varepsilon$$

H_{05}: ***There is no significant relationship between smallholding farming and household food security in West Pokot County*** $H_{05}$was modeled as:

$$Y_1 = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

H_{05}: ***There is no significant moderating influence of farmer association on the relationship between smallholder farming and household food security in West Pokot County*** H_{05}will be modeled as:

H_{05a}: ***There is no significant moderating influence of farmer association on the relationship between smallholder socio-economic factors and household food security in West Pokot County*** H_{05a} was modeled as:

$$Y = \alpha + \beta_1 X_1 + \beta_2 Z + \beta_3 X_1 * Z + \varepsilon$$

H_{05b}: ***There is no significant moderating influence of farmer association on the relationship between smallholder farming characteristics and household food security in West Pokot County*** $H_{05b}$was modeled as:

$$Y = \alpha + \beta_1 X_2 + \beta_2 Z + \beta_3 X_2 * Z + \varepsilon$$

H_{05c}: ***There is no significant moderating influence of farmer association on the relationship between farmers' household labour conditions and household food security in West Pokot County*** $H_{05c}$was modeled as:

$$Y = \alpha + \beta_1 X_3 + \beta_2 Z + \beta_3 X_3 * Z + \varepsilon$$

H_{05d}: ***There is no significant moderating influence of farmer association on the influence of climate variability on household food security in West Pokot County*** H_{05d} was modeled as:

$$Y = \alpha + \beta_1 X_4 + \beta_2 Z + \beta_3 X_4 * Z + \varepsilon$$

Where:

Y= Household Food Security
α = regression constant derived from the y-intercept,
β_1 to β_4 = regression coefficients,
X_1= Socio-economic Factors
X_2 = Smallholding farming characteristics
X_3 = Household Labor Conditions
X_4 = Climate Variability
Z= Farmer Association
ε = error term.

A summary of the objectives, hypothesis, analytical model and interpretation of results is presented in Appendix VII (pg. 241).

3.11.3 Qualitative Analysis

According to Merriam, (1998) and Boyatzis (1998) a qualitative data analyst should seek to describe their textual data in ways that capture the setting or people who produced this text on their own terms rather than in terms of predefined measures and hypotheses. This was further emphasized by Kawulich, (2004). Qualitative data was categorized for meaningful interpretations using constant comparative content analysis. The qualitative open-ended key informant interviews were used to collect detailed views from the participants and to define more clearly some of the variables being measured. Qualitative analysis was used to verify quantitative data. Qualitative data was mostly applied in triangulation of the quantitative data as presented by the respondents in the field to improve validity and reliability of all variables associated with household food security in the study area. Qualitative data was analysed using thematic analysis which meant that the data was categorized within the themes of the study which are aligned to the study variables. Thematic analysis was useful because it examines the meaning, insights and opinions of non-numerical data in a bid to access in-depth data.

3.12 Ethical Considerations

The researcher followed all codes of ethics and applied the 3 three principles of research ethics: beneficence, respect and justice as prescribed in the Belmont Report, to the fullest use, to ensure prudent ethics of research are followed. The researcher received an authorization permit from National Commission for Science Technology and Innovations (NACOSTI) to carry out the study in West Pokot County. Informed consent

was sought from smallholder farmers and key informants before administering the interview schedule, and conducting interviews respectively. Privacy and confidentiality was practiced during data collection and with data handling. All data collection tools were applied only after verbal voluntary informed consent is obtained. The researcher informed the respondents that the questionnaires issued and interviews done were solely for academic purposes and the information received was treated with utmost confidentiality.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION.

4.1 Introduction

This chapter entails the results of analysis of data obtained from the respondents from West Pokot County during the months of March and April 2019. This chapter is thematically organized into sections namely; response rate, demographic characteristics, validity and reliability tests, descriptive analysis, Simple and multiple regression analysis, hypothesis testing and summary of results.

4.2 Response Rate

A total of 241 respondents out of the sampled 282 respondents returned completely filled questionnaires representing a response rate of 85.4%, which supports Mugenda (2008) assertion that a response rate of 70% and above is excellent especially when considering generalizability of study findings to a wider population. The 14.6% non-response was as a result of voluntary refusal to fill the questionnaires. The strategies that were used to achieve a high response rate included establishing a contact person within the communities, sitting and waiting for the respondents to fill out the questionnaire and collecting it immediately, plus use of well-trained research assistants who dispersed the research instruments.

4.3 Demographic Characteristics

Demographic information was obtained from section A of the research questionnaire. The data collected included gender, age, level of formal education, marital status and of household head summarized in Table 4.1

Table 4.1: Demographic Characteristics of the respondents

Measure	**Indicators**	**Frequency**	**Percent**
Gender	Female	99	41.1
	Male	142	58.9
Age	<20	8	3.3
	20-29	52	21.6
	30-39	77	32.0
	40-49	48	19.9
	50-59	40	16.6
	>60	16	6.6
Formal Education	Transfer to objective 1**		
	No Education	100	41.5
	Primary	49	20.3
	Secondary	42	17.4
	Tertiary	24	10.0
	University	26	10.8
Marital Status			
	Single	48	19.9
	Married	123	51.0
	Married & Polygamous	44	18.3
	Widow/Widower	26	10.8
Household Head	Transfer to objective 1**		
	Yes	164	68.0
	No	77	32.0

Source: Field Data 2019

The results in Table 4.1 revealed that majority of the respondents were male as indicated by 58.9% of the respondents as compared to female who were 41.1% of the respondents, this is because they were the household heads. In regard to age, there was fair representation as the ages ranged from slightly less than 20 to over 60 years. The dominate group was between 30 and 39 as they were 32.0% and they were followed by between 20 and 29 as shown by 21.6% and between 40 and 49 years were 19.9%. Other age groups were between 50 and 59, 16.6%, over 60 years, 6.6% and less than 20 years were 3.3%.

In terms of education, 41.5% of the respondents were found to lack education while primary education was found to 20.3% of the sampled respondents. Secondary education was 17.4% of the sample respondents, 10.0% were found to have tertiary and 10.8% were found to be 10.8% of the sampled respondents. Half of the respondents, 51.0% were married while 19.9% of the sampled respondents were single. Polygamous were 18.3% and widow/widower were 10.8% of the sampled respondents. It can be deduced that 69.3% of the respondents were married. Lastly, 68% of the respondents were household head while 32.0% were not household heads. Therefore, majority of the respondents were in a position to give to required information in regard to food security situation in the household.

4.4 Socio-Economic Status of Small Holder Farmers

The first objective sought to examine the socio-economic status of the farmers and how they affect food security. The succeeding tables show the results.

4.4.1 Average household Income Spent on Farming

The sampled respondents were asked to state their household annual income. The results are as shown in Table 4.2.

Table 4.2: Respondents Average Household Income

Annual Income			**Spend on Farming**		
Kshs.	Frequency	Percentage	Ksh.	Frequency	Percentage
Less than 10,000	100	41.5	Less than 5,000	75	31.1
10,001-20,000	91	37.8	5001-10,000	74	30.7
20,001-30,000	17	7.1	10,001-15,000	46	19.1
30,001-40,000	13	5.4	15,001-20,000	22	9.1
Over 40,0000	20	8.3	Over 20,000	24	10.0
Pearson R correlation		0.588			
Significance level		0.000			

Source: Field Data 2019

From Table 4.2, majority of the sampled respondents earned less than 20,000 annually, with 41.5% of them earning less than 10,000 while 37.8% earning between 10,001 and 20,000. The results also indicated that 7.1% of the respondents earned between 20,001 and 30,000 while 5.4% earned between 30,001 and 40,000. Only 8.3% earned over 40,000 annually. On the other hand, 31.1% of the respondents spend less than 5,000 on farming, while 30.7% of the respondents spent between 5,001 and 10,000. It can be deduced that, 61.8% of the sampled respondents spent less than 10,000 on farming. However, 19.1% spent between 10,001 and 15,000, 9.1% spent between 15,001 and 20,000 while 10.0% spend over 20,000. Pearson correlation analysis indicated that there is significant relationship between average household income and amount of money spent on farming per years as indicated by P=0.588, P=0.000.

4.4.2 Percentage of income spent on Farming

The study sought to establish the amount of household income that is spent on farming and further to establish the breakdown in terms of tilling, planting, weeding, harvesting, storage, purchase of input and marketing. The results are as shown in Table 4.3.

Table 4.3: Respondents Percentage of Income spent on farming

Farming activity	Minimum	Maximum	Mean	Std. Deviation
Spent on Farming (Overall)	5.00	100.00	50.1220	23.22312
Tilling	2.00	70.00	23.9751	18.33551
Planting	.00	55.00	11.0622	8.46403
Weeding	1.00	30.00	10.4647	6.38029
Harvesting	.00	50.00	9.6058	8.15311
Storage	.00	25.00	4.3237	3.81486
Purchase Input	.00	25.00	8.1079	4.86535
Marketing	.00	15.00	3.8672	3.74597

Source: Field Data 2019

From Table 4.3, the sampled farmers spent between 5% and 100% of their income in farming. The mean percentage was 50.1% with a significant standard deviation of 23.3%. This implies that majority of the farmers spent between 27% and 77% of their income in farming. For specific farming practices, the sampled farmers spent between 2% and 70% on tilling with a mean of 24.0. In regard to planting, the sampled farmers spent between 0 and 55% with a mean of 11.1%. In relation to weeding, the sampled farmers spent between 1 and 30% of their income with a mean of 10.5%. The results further revealed that some of the respondents spent nothing on harvesting (1.7%), storage (14.5%), purchase input (2.5%) and marketing (27.0%). The results also revealed that farmers spent a mean of 3.9% of their income on marketing while a mean

of 4.3% was spent on storage. It can be deduced that there is little surplus that may be used for marketing or storage as far as farming in west Pokot county is concerned.

4.4.3 Adequacy of Income in Relation to Farming

The respondents were asked to indicate the level of adequacy from 1 (not all), to 5 (very adequate. The results are as shown in Figure 4.1.

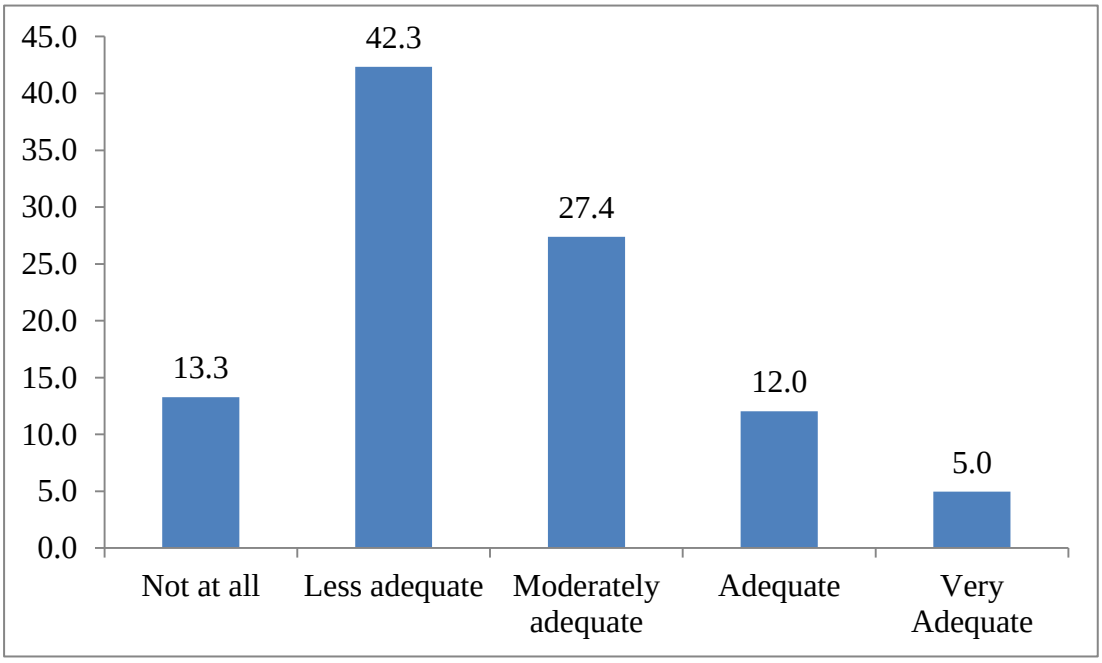

Figure 4.1: Respondents adequacy on income in relation to farming
Source: Field Data 2019

From Figure 4.1, 13.3%(32) of the sampled farmers indicated that there income was not adequate at all in relation to their farming requirement while small majority of sampled farmers 42.3%, 103 indicated that it is less adequate. The results further revealed that 27.4% (66) of the respondents indicated that the income in relation to farming requirements is moderately adequate. On the other hand, 12.0% (29) of the respondents indicated that it is adequate while 5.0% (12) is very adequate. From the findings, it is evident that 55.6% of the sampled farmers' income is less adequate to support their farming practices.

4.5 Farming Characteristics

The study also sought to establish farming characteristics of sampled farmers in West Pokot County. This was determined using size of household arable land, total of household farm under cultivation (Ha), type of food crop and number of times planted per season, by using of improved seeds, application of manure and fertilizer. The results are as follows.

4.5.1 Total Arable Household Size Land

The study sought to establish the total size of household arable land and the total size of household arable farm that is cultivated with food crop. The results are as shown in Table 4.4.

Table 4.4: Respondents Total Arable Household Size Land

Total Household land			**Total Cultivated land**		
Ha	Frequency	Percentage	Ha	Frequency	Percentage
0-1.0	59	24.5	0-1.0	78	32.4
1.01-2.0	62	25.7	1.01-2.0	91	37.8
2.01-3.0	71	29.5	2.01-3.0	41	17.0
3.01-4.0	30	12.4	3.01-4.0	24	10.0
4.01-5.0	19	7.9	4.01-5.0	7	2.9
Pearson R correlation		0.570			
Significance level		0.000			

Source: Field Data 2019

From Table 4.4, 24.5% (59) of the sampled farmers had between 0 and 1.0 hectares while 25.7% had between 1.01 and 2.0 hectares. The results also revealed that 29.5% of the respondents had between 2.01 and 3.0 hectares. In total, 79.7% of the sampled

farmers had between 0 and 3 hectares. On the other hand, 12.4% of the sampled respondents had between 3.01 and 4.0 hectares while 7.9% had between 4.01 and 5.0 hectares. In regard to size of land cultivated, 32.4% of the respondents cultivated less than a hectare, while 37.8% cultivated between 1.01 and 2.0 hectares. It can be deduced that 70.2% cultivated less than 2 hectares for food crop production. The results also revealed that 17.0% of the sampled farmers cultivated between 2.01 and 3.0 hectares, 10.0% of the sampled farmers cultivated between 3.01 and 4.0 hectares while 2.9% of them cultivated between 4.01 and 5.0 hectares. Pearson correlation analysis indicated that there is significant relationship between total size of household arable land and land size under food crop production as indicated by P=0.570, P=0.000.

The study further sought to establish factors that influence the size of household farm under food crop cultivation. Some of the reasons were, lack of resources especially funds to purchase farm inputs, tilling and other requirements as indicated by 43.9%, climate change especially prolonged drought, change of rain pattern and rain timing as indicated by 13.0%, Household size was another factor that determined as indicated by 15.4% of the sampled respondents, availability of labor 8.1%, skills and education in crop production 6.1% of the sampled respondents. Other factors that were identified are; age of the household head 4.9%, farming practices such as mixed farming and mixed crop 1.6%, and size of the land available 2.4%. The results also revealed that, some households do not value land cultivation and would rather practice livestock keeping among other factors such as; insecurity, lack of morale, and land tenure issues.

4.5.2 Type of Food Crop Cultivated per Season

4.5.2.1 Types of Food Crop

From the findings, it was evident that thirteen kinds of food crops are grown by the sampled farmers in West Pokot Sub County. Maize was grown by 100% of the respondents while beans were grown by 58.0% of the sampled farmers. Other food crops grown were vegetables 10.2%, potatoes 10.2%. bananas, 8.4%, cabbage 1.6%, carrots 0.8%, cassava 2.4%, cowpeas and legumes 1.6%, millet 7.0%, peas 2.4% and sorghum 2.4%. It was noted that majority of the sampled farmers grew more than one food crop. Only 27.0% of them grew one crop which was maize while 40.2% grew two crops which mostly comprised of maize and beans, maize and millet, maize and vegetables as well as maize and potatoes. The results also revealed that 18.7% of the sampled farmers grew three crops in their farm, maize and beans were dominant besides sorghum, millet, vegetable, bananas. Some sampled farmers grew up to four food crops in their farms which were dominated by maize and beans as indicated by 10.8% while 3.3% of the sampled farmer grew up to five crops. Others were bananas, cassava, potatoes, carrot, millet, legumes and vegetable. Therefore, mixed cropping was practiced by sampled farmers. The results are as shown in Table 4.5.

Table 4.5: Number of crops grown by the respondents

Number of Crops	Frequency	Percentage
One Crop	65	27.0
Two Crops	97	40.2
Three Crops	45	18.7
Four Crops	26	10.8
Five Crops	8	3.3

Source: Field Data 2019

The high percentage of farmers who grew maize was supported by one agricultural extension officers who said that:

> "*Most farmers in this area depend entirely on maize farming. They usually plant maize and intercrop with beans depending with the availability of beans seeds which are sometimes expensive to purchase".*
> (An Agricultural extension officer, Kilimo house-Kapenguria, 2019)

4.5.2.2 Acreage of Food Crop

The study also sought to establish the acreage under each food crop. The results are as shown in Table 4.6,

Table 4.6: Respondents acreage of food crop

Food Crop	Mean	Maximum	Minimum	Sum	Standard Deviation
Maize	2.60	10.00	.25	306.95	2.38
Beans	1.21	6.00	.01	89.43	.98
Potatoes	.52	2.00	.25	6.75	.49
Millet	.68	2.00	.13	6.13	.58
Vegetable	.27	.50	.13	3.75	.14
Banana	.34	1.00	.13	3.73	.25
Cowpeas	.75	1.00	.50	1.50	.35
Legumes	.63	1.00	.25	1.25	.53
Peas	.42	.50	.25	1.25	.14
Sorghum	.42	.50	.25	1.25	.14
Cassava	.33	.50	.25	1.00	.14
Cabbage	.38	.50	.25	.75	.18
Carrots	.13	.13	.13	.13	.

Source: Field Data 2019

From Table above, maize was grown in 306.95 acres and the mean acreage was 2.60. The farms under maize ranged from 0.25 to 10.0 acres. The second most grown crop

was beans with total acreage of 89.43 with a mean of 1.21 acres. It ranged from 0.01 to 6.0 acres. The third most grown crop was potatoes with a total of 6.75 acreage under cultivation and it ranged from 0.25 acres to 2.0 with mean acreage of 0.52. Another crop under cultivation in West Pokot County was millet with total acreage of 6.13 with a mean of 0.68 and it ranged from 0.13 to 2.0 hectares. Other crops were vegetable (Total=3.75, mean=0.27), banana (Total=3.73, mean=0.34), Cowpeas (Total=1.50, mean=0.75), legumes (Total=1.25, mean=0.63), peas (Total=1.25, mean=0.42), sorghum (Total=1.25, mean=0.42), Cassava (Total=1.00, mean=0.33), cabbage (Total=0.75, mean=0.38) and carrots (Total=0.13, mean=0.13).

4.5.2.3 Number of Times Cultivated per Season

From Table4.7, maize and cassava in West Pokot County was grown once per season for all sampled farmers. However, sorghum was grown between 1 and 2 seasons while millet, potatoes, vegetable, bananas and beans were cultivated between 1 and 3 seasons. On the other hand, cabbage was grown between 2 and 3 seasons while carrots, cowpeas, peas and legumes were grown thrice in a season.

Table 4.7: Crops and number of Times Cultivated per Season

Crop	Mean	Maximum	Minimum	Standard Deviation
Cassava	1.00	1.00	1.00	.00
Maize	1.00	1.00	1.00	.00
Sorghum	1.33	2.00	1.00	.58
Banana	1.36	3.00	1.00	.67
Beans	1.38	3.00	1.00	.73
Cabbage	2.50	3.00	2.00	.71
Carrots	3.00	3.00	3.00	.
Cowpeas	3.00	3.00	3.00	.00
Legumes	3.00	3.00	3.00	.00
Millet	1.33	3.00	1.00	.71
Peas	3.00	3.00	3.00	.00
Potatoes	2.69	3.00	1.00	.63
Vegetable	2.50	3.00	1.00	.85

Source: Field Data 2019

4.5.2.4 Use of Farm Inputs

The study also sought to establish the utilization of hybrid seeds, fertilizer and manure. The results are as shown in Table 4.8.

Table 4.8: Utilization of Farm Inputs

Use of Inputs	Improved Seed		Fertilizer		Manure	
	Frequency	%	Frequency	%	Frequency	%
Not at All	100	41.5			59	24.5
Less Often	56	23.2			102	42.3
Moderate	43	17.8			59	24.5
More often	29	12.0			16	6.6
Always	13	5.4			5	2.1

Source: Field Data 2019

From Table 4.8, 41.5% of the sampled farmers did not use improved seeds/seeding at all while 23.2% used improved seed less often. 17.8% used improved seeds moderately while 12.0% used more often and 5.4% of the sampled farmers used it always. The farmers used improved seed less often and not at all indicated that they are expensive as most of them are poor hence they cannot afford.

Another reason was that some areas could not access improved seeds and therefore, they utilized the available seeds. Further, few of the respondents indicated they lacked skills and knowledge to differentiate and identify which improved seeds to use.

On the other hand, 24.5% of the sampled farmers did not use manure at all, 42.3% used less often and 24.5% used it at moderate extent. Only, 6.6% used manure more often and 2.1% used it always to improve their farm productivity. The farmers who used manure and fertilizer less often and not all indicated that they lacked livestock in their farms to produce manure. Another reason was that it was difficult to transport manure from where livestock are kept to their farms while some of them had some belief that their land is naturally fertile so there was no need to use manure or fertilizers.

Information got from the Agricultural extension officers in the study area on the use of certified maize and bean seeds was that:

> *"Most farmers in West Pokot use certified maize seeds but only a few farmers use certified bean seeds. We are trying to encourage farmers to use certified seeds so as to improve on their productivity and enhance food security".*
> (An Agricultural extension officer, Kilimo house-Kapenguria, 2019)

4.5.2.5 Livestock Keeping

Majority of the sampled farmers kept livestock besides cultivating as indicated by 72.2% of them. The most kept animals were cattle, goats, sheep and poultry. This

implies that most of sampled farmers participated in mixed farming. This may cushion a household during low productivity from either crop farming or livestock production. The descriptive summary is as shown in the Table 4.9.

Table 4.9: Respondents number of livestock

Number of Livestock	Frequency		Percentage
Between 1 and 20	104		61.9
21 and 40	38		22.6
41 and 60	8		4.8
61 and 80	14		8.3
Over 80	4		2.4
Sum	3942	Maximum	120
Mean	16	Minimum	2

Source: Field Data 2019

The total number of livestock was 3,942 with a mean of 16 livestock per household. However, the minimum number of livestock was 2 and maximum was 120 livestock. Majority of the sampled farmers had between 1 and 20 livestock as shown by 61.9% while between 21 and 40 livestock were 22.6% of the farmers. Between 41 and 60 livestock were 4.8%, between 61 and 80 were 8.3% and over 80 livestock were 2.4%.

This study further sought to establish income earned from the livestock keeping. The results of the analysed information are presented in Table 4.10.

Table 4.10: Income earned from livestock

Income earned from livestock per year (Kshs.)		Frequency	Percentage
Less than 10,000		124	73.8
10,001-20,000		24	14.3
20,001-30,000		12	7.1
30,001-40,000		6	3.6
Over 40,000		2	1.2
Sum	**2,009,800**	**Maximum**	**100,000**
Mean	**11,963.10**	**Minimum**	**400**

Source: Field Data 2019

From Table 4.10, the total amount of money earned from livestock in West Pokot County ranged from Ksh. 400 to 100,000 with a mean of 11,963.10. The total income from livestock was Ksh. 2,009, 800. Majority of the sampled farmers earned less than Ksh. 10,000 as indicated by 73.8% while between 10,001 and 20,000 were 14.3% of the sampled farmers. Between Ksh. 20,001 and 30,000 were 7.1%, between 30,001 and 40,000 were 3.6 while above 40,000 were 1.2% of the sampled farmers. It can be deduced that majority of farmers earned less than 10,000 in a year from livestock farming.

Interview with a livestock extension officer in the study area showed that all households in the study area had cows and sheep or goats. He shared that:

> *"The climatic conditions in this area do not favour the keeping of improved livestock due to the fact that that some areas are arid. The indigenous breeds like cows that are kept by most farmers do not produce milk for both consumption and sale*"
> (An Agricultural extension officer, Kapenguria, 2019)

4.6 Household Labor Condition

The third objective was on Labor condition which was operationalized in to the number of household members involved in farming activities in terms of gender, number of hours spent on farm per day and utilization of extra labor. The findings are as follows;

4.6.1 Total Number of people in a household

The sampled respondents were asked to indicate the size of their household. The results are as shown in Table 4.11.

Table 4.11: Number of people in a household

Number	Frequency	Percentage
1	18	7.5
2-4	72	29.9
5-7	88	36.5
8-10	41	17.0
Over 10	22	9.1

Source: Field Data 2019

From the Table 4.11, 7.5% of the sampled households had one member, 29.9% had between 2 and 4 members, 36.5% had between 5 and 7 members, 17.0% had between 8 and 10 members while over 10 members were 9.1% of the household. It can be deduced that most of the sampled households had between 2 and 7 household members as indicated by 66.4% of the respondents.

4.6.2 Provision of Farm labor by Gender in the household

Table 4.12 presents the findings on responses concerning provision of farm labour in the study area.

Table 4.12: Provision of farm labor by Gender in the household

	Male		Female	
Number	Frequency	Percentage	Frequency	Percentage
1	109	45.2	99	41.1
2-3	99	41.1	109	45.2
4-5	25	10.4	24	10.0
6-7	2	.8	2	.8
Over 7	6	2.5	7	2.9

Source: Field Data 2019

From Table 4.12, 45.2% of the household had one male involved in farming while 41.1% of female were found to involve in farming. In regard between 2 and three households, 41.1% of them were male while 45.2% were female. More males were represented between 4 and 5 at 10.4% as compared to female at 10.0%. Both genders were equal represented between 6 and 7 as indicated by 0.8%. More female were represented in over 7 members as indicated by 2.0% as compared to 2.5% for male. T test indicated that there is no significant (MD=0.793, C.I=-0.205-0.106, P=0.530) difference between male and female involvement in farm labor as shown below although more female household members (Mean=1.792) were involved in farm labor as compared to male household members (Mean=1.742).

Table 4.13: Male and female Respondents on provision of farm labor by Gender

Group Statistics							
Gender	N	Mean	Std. Deviation		Std. Error Mean		
Male	241	1.7427	.86615		.05579		
Female	241	1.7925	.87471		.05634		
	t-test for Equality of Means						
	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Equal variances assumed	-.628	480	.530	-.04979	.07929	-.20560	.10601
Equal variances not assumed	-.628	479.954	.530	-.04979	.07929	-.20560	.10601

Source: Field Data 2019

4.6.3 Number of hours spent on farming by household members

The study further sought to establish the approximate number of hours spent on farming by both male and female members in the household. The results are as shown in Table 4.14.

Table 4.14: Hours spent on farming by household members

	Male		**Female**	
Hours	Frequency	Percentage	Frequency	Percentage
Less than 1	15	6.2	58	24.1
1-2	63	26.1	105	43.6
3-4	56	23.2	50	20.7
5-6	80	33.2	22	9.1
Over 6	27	11.2	6	2.5

Source: Field Data 2019

From Table 4.14, 6.2% of the respondents indicated that men spent zero hours in farms as compared to 24.1% of the respondents who indicated that female spent zero hours in farm. The results further revealed that 26.1% of male spent between 1 and 2 hours as

compared to 43.6% of female in West Pokot County. The results also revealed that 23.2% of male spent between 3 and 4 hours in a day as compared to 20.7% of female in their household. It was further revealed that 33.3% of the sampled respondents indicated that male in their household spent between 5 and 6 hours as compared to 9.1% of female.

A few females approximately 2.5% spent over six hours in a day as compared to 11.2% of male in the sampled households in West Pokot County. The study further sought to establish is there is significant difference between male and female hours. T test indicated that there is significant (MD=0.94606, C.I=-0.75586-1.13625, P=0.000) difference between male and female time in farm as shown in table below. This implies more male household members (Mean=3.1701) as compared to female household members (Mean=2.2241) spent more time in their farm.

Table 4.15: Number of hours spent on farming

Group Statistics						
Gender	N	Mean	Std. Deviation	Std. Error Mean		
Male	241	3.1701	1.12551	.07250		
Female	241	2.2241	.99562	.06413		
	t-test for Equality of Means					
	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference
						Lower / Upper
Equal variances assumed	9.774	480	.000	.94606	.09680	.75586 / 1.13625
Equal variances not assumed	9.774	472.958	.000	.94606	.09680	.75586 / 1.13626

Source: Field Data 2019

4.6.4 Farm activities performed by household members

The sought to establish specific farm tasks performed according to the genders. The results are as shown in Table 4.16.

Table 4.16: Farm activities performed in terms of gender

	Male		Female	
Task	Frequency	Percentage	Frequency	Percentage
Ploughing/Tilling	211	87.6	80	33.2
Planting/sowing	183	75.9	193	80.1
Weeding	187	77.6	173	71.8
Top dressing	169	70.1	135	56.0
Harvesting	185	76.8	165	68.5
Post harvesting e.g. winnowing, sorting, drying etc.	159	66.0	179	74.3
Livestock Keeping	199	82.6	54	22.4
Average		76.66		58.04

Source: Field Data 2019

From Table 4.16, male (87.6%) were involved in Ploughing of land as compared to female (33.2%). In planting, there were more female (80.1%) as compared to males (75.9%). More males (77.6%) were involved in weeding as compared to female (71.8%). On the other hand, less female were involved in top dressing as compared to male. Similar results were observed in harvesting and livestock keeping. However, more female (74.3%) were involved in post harvesting as compared to male (66.0%). In summary, more males (76.66%) were involved in both crop and livestock production as compared to female (58.04%) in West Pokot County.

Interviews conducted with the area chiefs in the study area pointed out that despite both genders being involved in both crop farming and animal husbandry, more males were involved in grazing of livestock as compared to females since male are considered to be masculine and are in a position to protect and guard their livestock against external aggressors. It also emerged that all household members were involved in farm activities

like harvesting of crops but once the crops are taken to homesteads, women take over the remaining roles. This was supported by a chief who said that:

> *"In our community most of the business transactions are carried out by men while women are left to carry out household chores and attend to children".* (Chief, West Pokot, 2019)

4.6.5 Frequency of use of labour in the Farm

The respondents were asked to indicate how frequently they use family labor in their farms and at the same if they use paid labor. The results are as indicated in Table 4.17.

Table 4.17: Frequency of use of Labor in the Farm

Household Labor			**Non Household Labor**	
Frequency	Frequency	Percentage	Frequency	Percentage
Not at all	1	.4	135	56.0
Less Often	5	2.1	44	18.3
Moderate	20	8.3	34	14.1
More often	73	30.3	27	11.2
Always	142	58.9	1	.4

Source: Field Data 2019

From Table 4.17, only 0.4% of the sampled respondent did not use household labor while 2.1% of the sampled farmers used less often. Majority of households in West Pokot always used family labor as indicated by 58.9% while 30.3% used family labor more often in their farms. On the hand, only one of the respondent always used non-household labor while 56.0% of the respondents did not used non-household labor at all. The results also revealed that 18.3% used non-household labor less often while 14.1% moderately used non-household labor. Most of those who did not use non-household labor indicated it is expensive and therefore, they resorted to utilize their family labour. Those respondents who used non-household labor mostly used tractors

to plough the land and they sometimes hired labourers when they were planting and harvesting.

4.7 Climate Variability

The fourth objective was on climate variability which in this study was conceptualized as changes in rainfall pattern, rainfall timings and number of hot days in a season (year). The findings are as follows;

4.7.1 Change in Weather over the last 20 years

The respondents were asked to indicate significant changes in weather they have observed in the last 20 years in their community. The results are as shown in Figure 4.2.

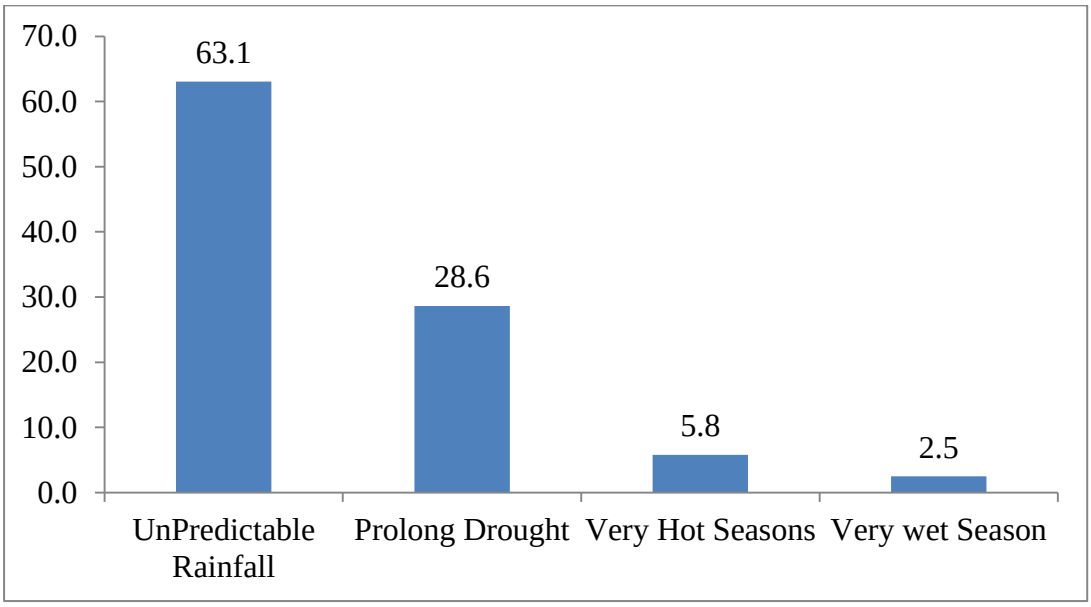

Figure 4.2: Patterns of Weather change over the last 20 years

Source: Field Data 2019

From Figure 4.2, 63.1% (152) of the sampled respondents indicated that the significant changes over the last 20 years was unpredictable rainfall pattern, 28.6% (69) indicated prolonged drought, 5.85% (14) revealed very hot seasons and 2.5% (6) indicated there was change in terms of very wet seasons.

The study further sought to find out what has happened to the number of hot days over the last 20 years in West Pokot County. The results are as shown in Table 4.18.

Table 4.18: Patterns of Weather change over the last 20 years

Changes in the number of hot days	Frequency	Percentage
Nothing	11	0.0
Increased	176	73.0
Declined	4	1.7
More extreme	42	17.4
Less Extreme	19	7.9

Source: Field Data 2019

From Table 4.18, the number of hot days in the last 20 years has increased as indicated by 73.0% of the sampled respondents. On the hand, only 1.7% of the respondents indicated that the number of hot days have declined in the last 20 years. The results also revealed that 17.4% of the respondents indicated the number of hot day over the last 20 years have been extreme as compared to 7.9% who indicated that the number of hot days in the last 20 years has been less extreme.

The study also sought to establish what has happened to the number of rainfall days over the last 20 years. The results are as shown in Table 4.9.

Table 4.19: Number of rainfall days over the last 20 years

Number of rainy days over the last 20 years	Frequency	Percentage
Increased	2	0.8
Declined	141	58.5
Change in Timing	40	16.6
Decrease in rain and Change in timing	42	17.4
Change in Frequency of drought/flood	16	6.6

Source: Field Data 2019

The results revealed that majority of the respondents (58.5%) indicated that there has been decline in amount of rainfall timing while 16.6% indicated that there has been change in rainfall timing. The results further revealed that 17.4% indicated that there has been both decrease and change in timing of rainfall. However, 6.6% indicated there has been change in frequency of drought/flood although 0.8% indicated that there has been increase in rainfall over the last 20 years.

4.7.2 Main impact of Climate Change on the Local Community

The study further sought to establish the main impact of climate change on the local household. The results are as shown in the Figure 4.3.

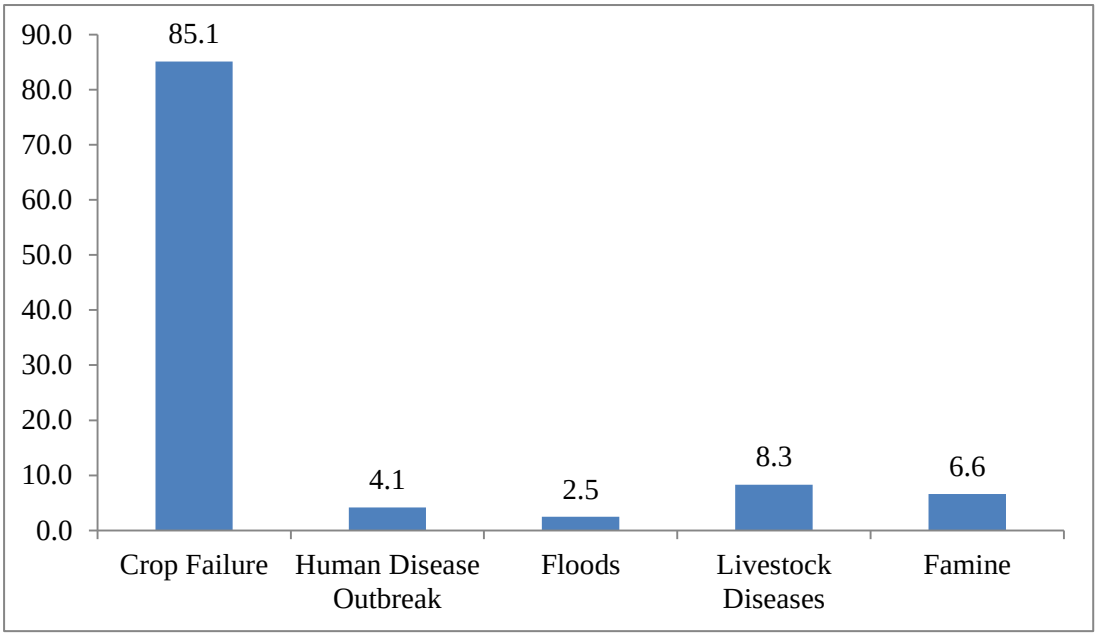

Figure 4.3: Responses on the impact of Climate Change

Source: Field Data 2019

The Figure 4.3 shows that majority of the sampled respondents indicated that climate change has had a major impact on crop growing as it has resulted to crop failure while 8.3% indicated it has resulted to livestock diseases. The results further revealed that climate change has resulted to famine, 4.1% has resulted to human diseases outbreak while 2.5% indicated it has results to flood.

The study further sought to establish the effect of climate change on crop production, livestock production, income generation, human health and water resources. It was revealed that climate change had resulted to reduction in crop production. Prolonged drought has resulted to drying of crops reducing the yield while change in rainfall timing has resulted to instances of army worm infestation which has affected crop productivity negatively.

Interviews with key respondents indicated that livestock production in the study area had decreased due to lack of pasture and water as well as outbreak of livestock diseases. This has forced many of the households to sell their livestock at low prices. Similarly, there has also been an increase in livestock rustling especially on the drier areas due to decrease in household herds resulting to human conflicts.

Majority of the respondents also indicated that change in climate has resulted to increase in human diseases which have affected human health negatively. During times of flood, there has been incidences of water borne disease outbreak especially cholera. An increase of number of hot days has resulted to increase in vector borne diseases especially malaria. Children and the elderly have also suffered from malnutrition due to famine associated with climate change.

Another effect of climate change has been drying up of water points both for livestock and human consumption. Prolonged drought has resulted to decrease in water sources which further has resulted to constant conflicts due to competition for pasture and water points. Most of the respondents also indicated that climate change has resulted to decrease in income as it affects both crop and livestock production. Man especially household heads are unable to participate in income generation activities due to

sickness, insecurity and lack of energy. Therefore, currently they have no livelihood option to circumvent the brunt of climate change.

The respondents were also asked to indicate how unpredictable rainfall, change in temperature and change in rainfall amount affect crop and livestock production. The results are as shown in Figure 4.4.

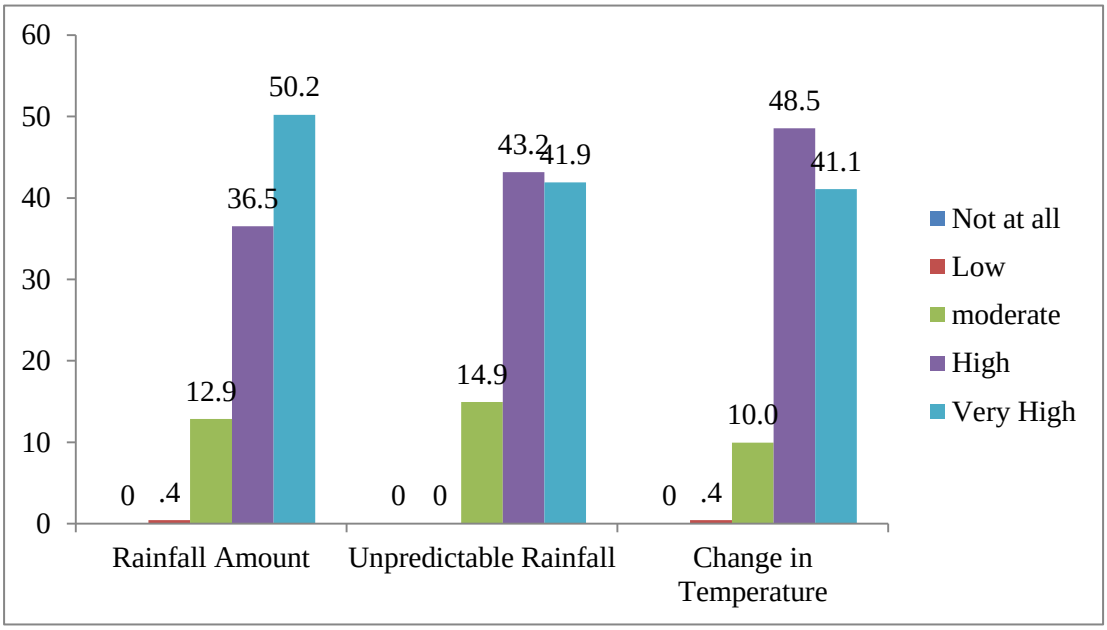

Figure 4.4: Indications on rainfall and temperature that affects farming
Source: Field Data 2019

From Figure above, 50.2% of the sampled respondents indicated that change in rainfall has affected crop and livestock production at very great extent while 36.5% indicated that it has affected them at great extent. In regard to unpredictable rainfall, 41.9% of the respondents indicated it has affected food and livestock productivity at very great extent while 43.2% indicated at great extent. Lastly, 41.1% of the sampled respondents indicated that change in temperature has affected livestock and crop production at very great extent while 48.5% of the respondents indicated it has affected them at great extent.

4.7.3 Adjustment in farming practices due to Climate Variability and Change

Ninety point nine percent (90.9%) of sampled respondents were asked to indicate if they have made adjustments in their farming practices as compared to 9.1% of the sampled respondents. The study further sought to establish what adjustment they have made. The results are as shown in Table 4.20.

Table 4.20: Respondents Adjustment in Farming Practices

Type of Change in farming practice	Frequency	Percentage
Change crop variety	102	42.3
Build water harvesting schemes	16	6.6
Implement soil conservation schemes	20	8.3
Diversification of crop types and varieties	43	17.8
Diversification of livestock types and varieties	20	8.3
Changing planting dates	98	40.7
Changing size of land under cultivation	27	11.2
Irrigation	19	7.9
Reduce number of livestock	41	17.0
Diversify from farming to non-farming activity	21	8.7

Source: Field Data 2019

From Table 4.20, 42.3% of the sampled respondents changed crop variety in order to cope with climate change and variability. They were followed closely by 40.7% of the respondents who changed planting dates. The results further revealed that 17.8% of the respondents adopted diversification of crop types and varieties while 17.0% reduced their number of livestock, 11.2% changed size of their land under cultivation. Other action taken by household included diversify from farming to non-farming activity (8.7%), diversification of livestock types and varieties (8.3%), implement soil

conservation schemes (8.3%), irrigation (7.9%) and build water harvesting schemes (6.6%).

Further interviews with key respondents indicated that most of the farmers in the study area were being advised by both the government and non-governmental agencies to adopt strategies that enhance food production within the shortest time possible owing to the erratic rainfall patterns in the area. One of the NGO interviewee said that:

> "*We are working with the County government of West Pokot to encourage the use of certified crop seeds that take short periods to mature and construction of community water pans in the area to cushion livestock farmers from losses occasioned by droughts".*
> (Non-governmental organization officer, 2019)

The study further sought to establish main constraints to the above indicated measures as none of the measure was practiced by more than half of the sampled respondents. The results are as shown in Table 4.21.

Table 4.21: Constraints faced due to adjustment of farming practices

Constraints	Frequency	Percentage
Lack of Capital	118	49.0
Lack of Information	75	31.1
Shortage of labor	18	7.5
Lack of access to water	26	10.8
Poor Health	4	1.7

Source: Field Data 2019

From the Table 4.21, 49.0% of the respondents indicated they are unable to adopt measures on climate change and variability due to lack of capital, 31.1% of the respondents indicated they lack information of various adaption measures, 10.8% indicated there is shortage of labor, 7.5% indicated they lack water and 1.7% indicate health has been a problem in the adaption.

The study further sought to find out whether there were institutions/organization in the local community that have worked with the sampled household to address the effect of climate change in on their livelihood. The results revealed that 55.6% (134) indicated they there institutions/organizations that work with locals to address effects of climate change.

The Figure 4.5 shows some of the organization/institutions are involved in addressing effects of climate change;

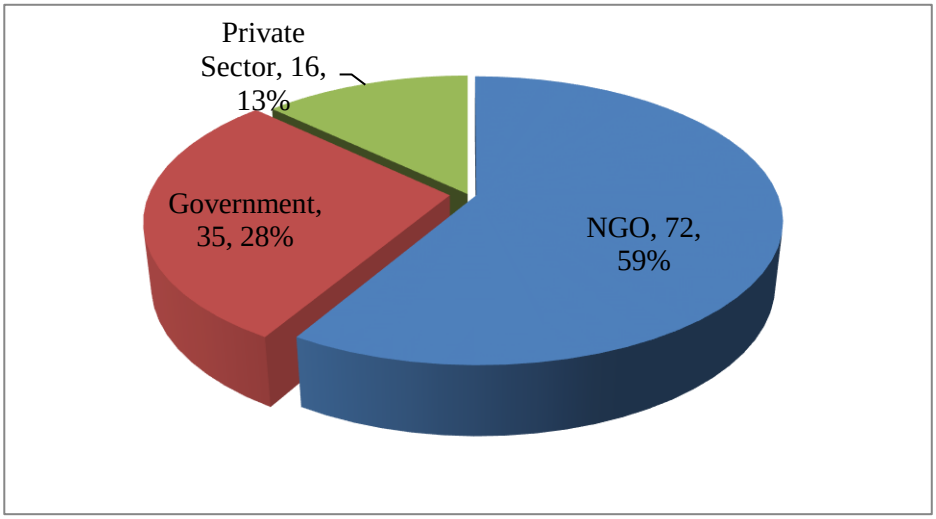

Figure 4.5: Sectors involved in addressing effects of climate change
Source: Field Data 2019

From the Figure 4.5, majority of the sample respondents indicated that NGO are working with the local to address the issues of climate change as indicated by 59.0% while 28.0% indicated that the government has been working with the local community and 13.0% indicated that the private sector has been essential in addressing issues of climate change in West Pokot County.

4.8 Household Food Security in West Pokot County

The study further sought to investigate the household food security in the study area. This section therefore discusses the household food security in West Pokot County.

4.8.1 Food Crop Harvest in the Previous Season

Table 4.22: Food Crop harvested in the Previous Season

Food crop	Mean	Percentage	N	Std. Deviation	Sum	Min	Max
Bananas	5.6880	4.1	10	2.10538	56.88	3.00	9.00
Beans	2.2281	59.8	144	2.22226	320.84	.30	10.00
Cabbage	9.1467	2.5	6	4.86360	54.88	3.00	13.33
Cassava	5.3333	2.5	6	3.61478	32.00	1.00	9.00
Legumes	1.0000	0.8	2	.00000	2.00	1.00	1.00
Maize	14.2448	95.9	231	17.70759	3290.56	1.00	100.00
Millet	1.8000	5.8	14	.75243	25.20	.60	3.00
Green grams	2.0000	0.8	2	.00000	4.00	2.00	2.00
Peas	3.7800	1.7	4	2.05537	15.12	2.00	5.56
Potatoes	5.7536	11.6	28	3.15871	161.10	3.00	12.00
Sorghum	.6250	1.7	4	.43301	2.50	.25	1.00
Kales	5.5000	1.7	4	5.19615	22.00	1.00	10.00
Vegetable	3.0000	6.6	16	2.51814	48.00	1.00	8.00
Total	8.5670		471	13.74820	4035.08	.25	100.00

Source: Field Data 2019

From Table 4.22, a total of 4,035 90kg of foods were produced by the sampled respondents. Maize was produced in plenty as indicated by 3,291 90kg which is 8.15% of the total food crop produced in West Pokot County. It was followed by beans 321 bags, potatoes 161.1 bags. Other crops were bananas 57 bags, cabbage 55 bags, legumes 2 bags, millet 25 bags, green grams4 bags, peas 15 bags, sorghum 3 bags, kales 22bags and vegetable 48 bags.

Majority of the farmers produced maize as indicated by 95.9%, beans were 59.8% of the sampled respondents and potatoes were 11.6% of the sampled respondents. Few of the sampled respondents produced banana 4.1%, cabbage 2.5%, cassava 2.5%, legumes 0.8%, millet 5.8%, green grams 0.8%, sorghum 1.7%, kales 1.7% and vegetable 6.6%.

4.8.2 Adequate Food Grown to Feed the Household

The respondents were asked to indicate if they are able to grow enough food to feed their family. The results are as shown in Figure 4.6.

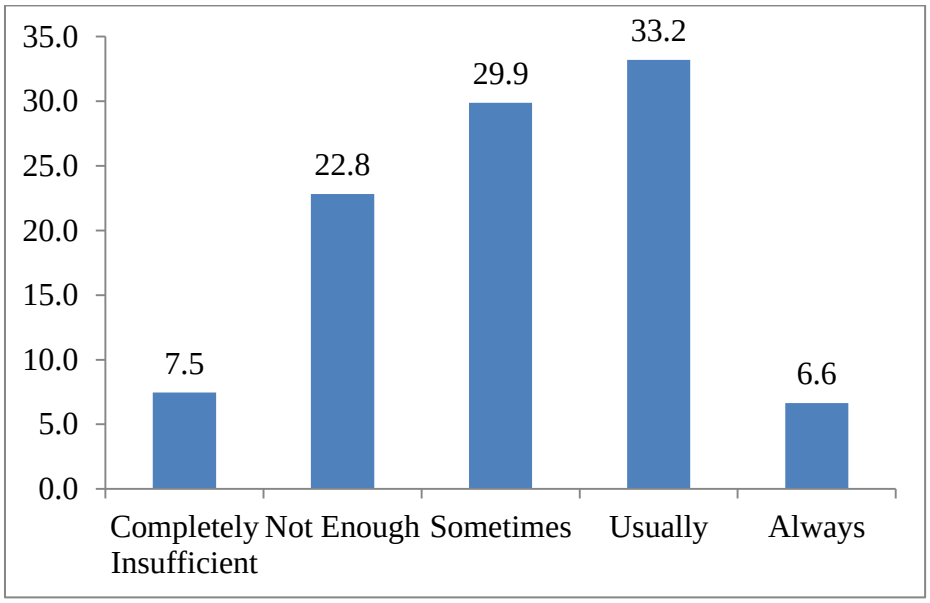

Figure 4.6: Adequacy of Food Grown to Feed the Household
Source: Field Data 2019

From Figure 4.6, 33.2 %(80) of the respondents indicated that they usually grow enough food to feed their family while 6.6% (16) indicated they always grow enough food. On the other hand, 7.5% (18) they grow completely insufficient food to feed their family while 22.8% (55) they grow not enough food to feed their family. However, 29.9% (72) sometimes grow enough food to feed their family.

When asked to state some of the reasons, why they grow sometimes less food to feed their families, majority of the respondents (66.6%) indicated that they lacked resources

to plough bigger land for crop production as they required seeds, labor and other farm inputs. Other reasons were, they are forced to buy their farm produce especially maize so as to cater for their family needs such as school fees. The respondents also indicated that they had large households which indicate that whatever is produced through farming cannot cater for their household food security. External factors were also blamed especially climate change causing drought thus reducing crop yield and instances such as infestation of army worms.

4.8.3 Shortage of Main Food Items

The respondents were asked if they experience shortages of main food items. Majority of the respondents confirmed that they experience shortage of main food items as indicated by 61.8% (149) as compared to 38.2 %(92) who do not experience food shortage. The study further asked them (who do not experience food shortage) to indicate which food crop they produce in surplus. The results are as shown in Figure 4.7.

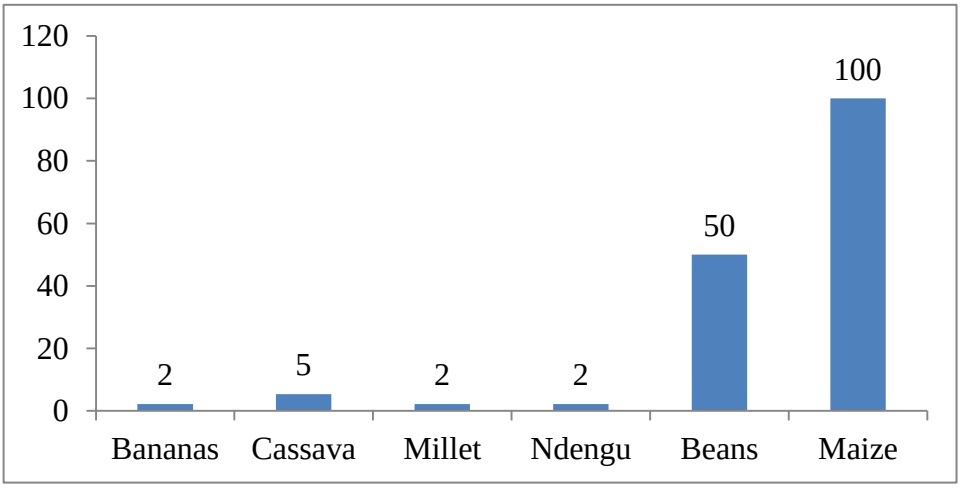

Figure 4.7: Types of foods that respondents experience shortage.

Source: Field Data 2018

It is evident that all sampled respondents who indicated that they did not experience food shortage had maize surplus. On the other hand, half of them (46) had beans surplus, 5.4% (5) had cassava surplus, 2.2% (2) had bananas, cassava and Ndegu surplus.

The study further sought to find out how many food deficient months the household experienced. The results are as shown in Figure 4.8.

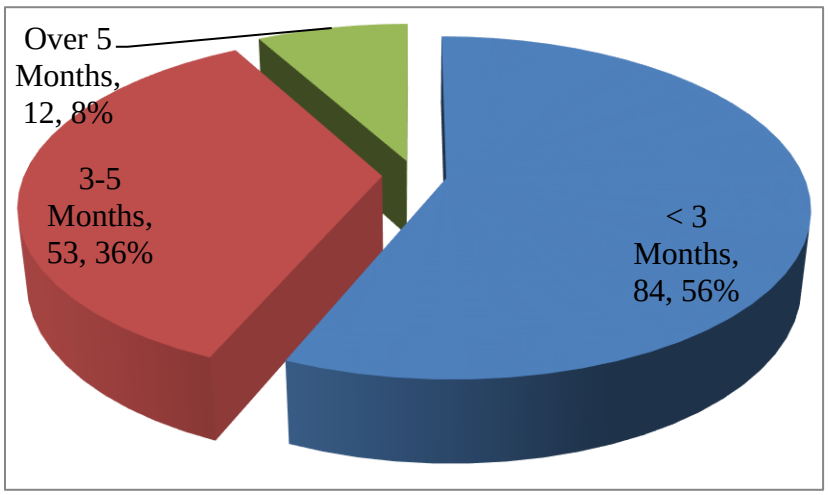

Figure 4.8: Respondents food deficient months
Source: Field Data 2019

It is evident that slight majority of the respondents experienced food crisis for less than three months as indicated by 56.0% of the sampled respondents while between three and five months were 35% of the respondents. Over five months were 8% of the sample respondents.

The study further sought to establish some of the reasons for food shortage. The results are as shown in Figure 4.9.

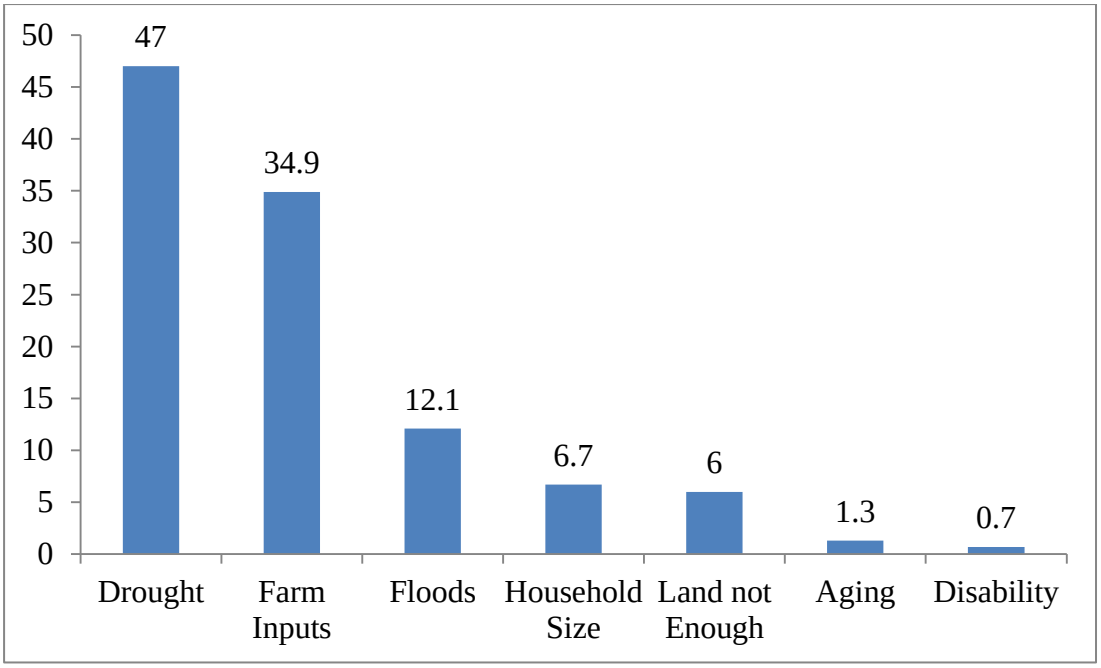

Figure 4.9: Respondents reasons for food shortage

Source: Field Data 2019

From figure above, 47.0% (70) of the respondents indicated drought was the reason why they experienced food shortage while 34.9% (52) indicated lack of farm inputs and 12.1% (18) indicated floods. Other reasons were large household which forced them to sell maize to meet other household expenses, small size of land other cultivation, ageing household and disability.

Table 4.23: Respondents coping strategy index

Coping Strategy employed	Number of Days								Mean Days
	0	1	2	3	4	5	6	7	
Rely on less preferred and less expensive food	7.1 (17)	0.8 (2)	3.3 (8)	8.7 (21)	16.6 (40)	18.3 (44)	16.6 (40)	28.6 (69)	4.9 (5)
Borrow food or rely on help from friends and relatives	10.4 (25)	4.1 (10)	7.1 (17)	10 (24)	15.8 (38)	17.8 (43)	15.8 (38)	19.1 (46)	4.3 (4)
Limit portion size at mealtime	9.5 (23)	7.5 (18)	6.6 (16)	6.2 (15)	18.3 (44)	19.9 (48)	21.2 (51)	10.8 (26)	4.1 (4)
Restrict consumption by adults in order for small children to eat	12.4 (30)	9.5 (23)	3.7 (9)	5 (12)	11.6 (28)	19.5 (47)	22.8 (55)	15.4 (37)	4.2 (4)
Reduce number of meals eaten in a day	10 (24)	3.7 (9)	5.8 (14)	13.3 (32)	21.6 (52)	12.4 (30)	9.5 (23)	23.7 (57)	4.3 (4)

Source: Field Data 2019

From Table, 7.1% of the respondents did not rely on less preferred and less expensive food in the last seven days, 10.4% did not borrow food or rely on help from friends and relatives, 9.5% did not limit portion size at mealtime, 12.4% did not restrict consumption by adults in order for small children to eat and 10% did not reduce number of meals eaten in a day. The mean day for those respondents which rely on less preferred and less expensive food was 4.9 which is equivalent to five days in the last seven days. The mean number of days that sampled respondents borrow food or rely on help from friends and relatives was 4.3 (4 days), limit portion size at mealtime was 4.1 (4 days), restrict consumption by adults in order for small children to eat was 4.2 days (4 days) and reduced number of meals eaten in a day was 4.3 (4 days).

The study further computed the Coping Strategy Index (CSI) to measure food security in terms of Weighted Score, Ratio and categorized them into five categories. The

weighted scores were obtained multiplying the number of days that household relies on less preferred and less expensive food by 1 factor, multiplying the number of days that household borrow food or rely on help from friends and relatives by 2 factor, multiplying the number of days that household limit portion size at mealtime by 1 factor, multiplying the number of days that household restrict consumption by adults in order for small children to eat by 3 factor and multiplying the number of days that household Reduce number of meals eaten in a day by 1 factor. The minimum weighted score is zero (0) while the maximum household score in household is 56. The following equation was used to calculate the weighted score per household using coping strategy index

CSI Weighted Score = ∑ (RLF×1, BFF×2, LPS×1, RCA×3, RNM×1)

Where RLF: is the number of days household relied on less preferred and less expensive food

BFF: is the number of days household borrowed food or rely on help from friends and relatives

LPS: is the number of days household limited portion size at mealtime

RCA: is the number of days household restricted consumption by adults in order for small children to eat

RNM: is the number of days household reduced number of meals eaten in a day

The status of household food security in West Pokot County was arrived using a ratio as indicated by the following formula:

Food Security Index=$\frac{\sum_{j=1}^{m} \mathbf{CSIj}}{\boldsymbol{m}*\mathbf{56}}$……..Equation 4.2

Where: j=1, 2, 3……m, and m= total number of Households in this study (241)

Table 4.24: Food security Index

Statistics	Weighted Score	Ratio (FSI)
Mean	34.47106	.61555
Std. Deviation	13.805766	.246530
Minimum	.000	.000
Maximum	54.000	.964

From Table 4.24, the mean weighted score was 34.47 out of maximum of 56 which when converted to ratio it is 0.616. This implies that 61.60% of the households in sampled respondents from West Pokot County are struggling with food security. It can also be interpreted that in every 10 households, 4 are food secure. The minimum weighted score was 0.00 implies that some household in West Pokot did not adopt any of the coping strategy. However, a maximum of 54.0 postulated that some household in West Pokot County relied to the above coping strategy up to 96.4% for their survival.

Interviews with key respondents however pointed out that despite government and non-governmental organizations' efforts in encouraging use of strategies that enhance food security, most of the residents in the study area were food insecure and depended on both government and non-governmental organizations for food supplies during prolonged droughts.

4.9 Model Testing

The study used 9 models although the null hypothesis was tested using multiple linear regression using unstandardized B coefficient and their respective significance level. The first four models were tested using simple linear regression analysis where each independent variable was regressed against food security in West Pokot County. The fifth models were tested using multiple linear regressions. The sixth, seventh, eighth and ninth models were tested using hierarchical linear regression analysis where the effect of group formation was investigated. An overall model was presented whereby; all the independent variables plus the moderating variable were regressed against food security.

4.9.1 Role of Socio-Economic Factors on Smallholder Farmer's Food Security

A simple linear regression was carried out to examine role of socio-economic factors on smallholder farmers' contribution to household food security in West Pokot County. This entails composite variable of socio-economic factors which was mean obtained from three main metrics that was used to measure socio-economic factors. The observable variables were amount of money spent on farming per year, skills and education level of household head in relation to agriculture and household decision in relation to land use. Similarly, the composite value of household food security was obtained by getting mean of five observable variables that was used to measure food security at household level. The detailed results of simple linear regression analysis involving socio-economic factors and household food security is as shown in Table 4.25 which is composite table comprising of Model summary, ANOVA and regression coefficients.

Table 4.25: Simple Regression Analysis Results: Socio-Economic Factors

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.574a	.329	.327	.98676

a. Predictors: (Constant), SEC

ANOVAa

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	114.281	1	114.281	117.368	.000b
	Residual	232.715	239	.974		
	Total	346.996	240			

a. Dependent Variable: Food Security

b. Predictors: (Constant), SEC

Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.540	.149		3.617	.000
	SEC	.699	.065	.574	10.834	.000

a. Dependent Variable: Food Security

From Table 4.25, looking at R column, we can deduce that socio-economic factors have significant positive moderate relationship with household food security in West Pokot County as indicated by R=0.574, P=0.000. This implies that improvement in socio-economic factors such as income spent on farming, knowledge and skills in farming would result to realization of household food security. The proportion of variance in household food security that is explained by the independent variable (socio-economic factors) is 32.9% or R2=0.32.9. The other variations of 67.1% were explained by other factor outside this model.

In order to assess the model significance, simply whether the model fits well the given data, the study resorted to F ration. The F-ratio from the findings indicates the ratio of the improvement in the prediction that results from fitting the model relative to the inaccuracy that still exists in the model. From the findings, the F ratio is greater than 1, as indicated by a value of 117.368, which means that improvement due to fitting the

model is much greater than the model inaccuracies (F(1,241)= 117.368, P=0.000). The F value is large which is very unlikely to have happened by chance (p<.05), thus implying that the final model significantly improves the ability to predict household food security. This also implies that socio-economic factors are useful predictor of household food security in West Pokot County.

From the findings presented in Table 4.25, socio-economic factors carried positive significant predictive power while the constant carried positive and significant value. This implies that if socio-economic factors are held at zero or it is absent, the household food security will be significantly at 0.540, p=0.000. The β coefficient of socio-economic factors was 0.699. This values is significant (β=.699, p=.000) implying that a unit change in socio-economic factors would result to significant change in household food security by 0.699 units. Therefore, the linear regression results indicated that there was a statistically significant positive relationship between household food security in West Pokot County and socio-economic factors. The study developed analytical model shown below for predicting food security from socio-economic factors is stated in the form of:

Yhfs=0.540+0.699 (X) Socio-Economic Factors

4.9.2 Influence of Smallholder Farming On Household Food Security

Simple linear regression analysis was used to determine changes in household food security that has been explained by smallholder farming characteristics. Data used for this model was obtained by asking sampled respondents to indicate the size of land under food crop production, types of food crop, application of manure and fertilizer, utilization of improved seeds/seedling as well as income from livestock. The composite index of the small holder farming characteristics observable variables and household food security of sampled respondents was computed and an inferential analysis

performed to evaluate the influence of smallholder farming characteristics on the household food security.

Table 4.26 is a composite table which contained ANOVA (goodness of fit; F Ratio, Sig Value) and model summary (R, R2, Adj R2) and regression coefficient (Unstandardized & standardized), t-value and Sig. value results. Findings were as shown in Table 4.26: Regression Results, Smallholder Farming Characteristics.

Table 4.26: Regression Results, Smallholder Farming Characteristics

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.649a	.421	.419	.91649

a. Predictors: (Constant), Farming characteristics

ANOVAa

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	146.247	1	146.247	174.113	.000b
	Residual	200.749	239	.840		
	Total	346.996	240			

a. Dependent Variable: Food Security

b. Predictors: (Constant), Farming characteristics

Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	**(Constant)**	.019	.162		.117	.907
	Farming X	.912	.069	.649	13.195	.000

a. Dependent Variable: Food Security

Table 4.26, the R value show the correlation coefficient between smallholder farming characteristics and household food security in West Pokot County. R=0.649 implies that there is significant relationship between smallholder farming characteristics and household food security in West Pokot County. The results revealed a coefficient of determination (r2) of 0.421. Meaning smallholder farming characteristics can explain 42.1 % of the variance in household food security in West Pokot County. The adjusted r square attempts to produce a more honest value to estimate r square for the population.

The F test gave a value of (1, 240) = 174.113, P<0.01, which was large enough to support the goodness of fit of the model in explaining the variation in the dependent variable. It also means smallholder farming characteristics is a useful predictor of household food security in West Pokot County.

The results of coefficients in Table 4.26 show that smallholder farming characteristics had a statistically significantly unique contribution in the prediction of the household food security in West Pokot County. Therefore, we reject our null hypothesis and conclude that smallholder farming characteristics have a significant influence on the household food security in West Pokot County. Smallholder farming characteristics had a positive β coefficient = 0.912 an indication that a unit change in the smallholder farming characteristics is likely to lead to a change in the household food security in West Pokot County by 0.912 units in the same direction. The model for this objective is as follows

Yhsf=0.019+0.912 X2(Smallholder farming Characteristics)

Therefore, we conclude at 5% significance level that smallholder farming characteristics has a significant positive influence on the household food security in West Pokot County, such that increase in the size of arable land under food crop production, increase in mixed crop and mixed farming, utilization of improved seeds/seeding and application of manure as well as fertilizer would results to increase in household food security in West Pokot County.

4.9.3 Role of Household Labor Conditions on Household Food Security

The study conducted a simple linear regression examine role of farmers household labor conditions on household food security West Pokot County. This entails composite variable of socio-economic factors which was mean obtained from observable variables

such as number of household members participating in farming, number of hours spent on farm per pay, use of extra labor in the farm. Similarly, the composite value of household food security was obtained by getting mean of five observable variables that was used to measure food security at household level. The detailed results of simple linear regression analysis involving socio-economic factors and household food security is as indicated in Table 4.27 which is composite table comprising of Model summary, ANOVA and regression coefficients.

Table 4.27: Simple Regression Analysis Results: Household labor conditions

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.610a	.372	.370	.95466

a. Predictors: (Constant), Household Labor

ANOVAa

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	129.176	1	129.176	141.738	.000b
	Residual	217.819	239	.911		
	Total	346.996	240			

a. Dependent Variable: Food Security
b. Predictors: (Constant), Household Labor

Coefficientsa

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	.491	.141		3.475	.001
HH labor	.670	.056	.610	11.905	.000

a. Dependent Variable: Food Security

From Table 4.27, scanning at R column, it is evident that household labor conditions have significant positive moderate relationship with household food security in West Pokot County as indicated by R=0.610, P=0.000. This implies that increase in household labor conditions such as more of family member offering labor in farms, increase in the number of time spent on farms and supplementing household labor with paid labor would results to increase in household food security.

The proportion of variance in household food security that is explained by the independent variable (household labor conditions) is 37.2% or R^2=0.372. The other variations of 62.8% were explained by other factor outside this model. In order to assess the model significance, simply whether the model fits well the given data, the study resorted to F ration. The F-ratio from the findings indicates the ratio of the improvement in the prediction that results from fitting the model relative to the inaccuracy that still exists in the model. From the findings, the F ratio is greater than 1, as indicated by a value of 141.738, which means that improvement due to fitting the model is much greater than the model inaccuracies (F(1,241)= 141.738, P=0.000). The F value is large which is very unlikely to have happened by chance ($p<.05$), thus implying that the final model significantly improves the ability to predict household food security. This also implies that household labor conditions are useful predictor of household food security in West Pokot County.

From the findings presented in Table 4.3, household labor conditions carried positive significant predictive power and the constant carried positive and significant value. This implies that if household labor conditions are held at zero or it is absent, the household food security will be significantly at 0.490, p=0.000. The unstandardized β coefficient of household labor conditions was 0.670. This values is significant (β=.670, p=.000) implying that a unit increase in household labor conditions would result to significant increase in household food security by 0.70 units. Therefore, the linear regression results indicated that there was a statistically significant positive relationship between household food security in West Pokot County and household labor conditions. The developed analytical model is shown below which predicts food security from household labor conditions is stated in the form of:

$$Y_{hfs}=0.491+0.670\ (X_3)$$ **Household labor conditions**

4.9.4 Influence of climate variability on farmers activities

Simple linear regression analysis conducted to determine the influence of climate variability on smallholder farmers' activities towards achieving household food security in West Pokot County. Data used for this model was obtained by asking sampled respondents to indicate how increase in temperature (Hot days), change in rainfall pattern and change in rainfall amount has affected crop and livestock production. From these observable variables, the study was able to compute the latent variable climate variability in West Pokot Sub County. The composite index of the small holder farming characteristics observable variables and household food security of sampled respondents was computed and inferential analysis performed to determine the influence of climate variability on the household food security. Table 4.4 is a composite table which contained ANOVA (goodness of fit; F Ratio, Sig Value) and model summary (R, R^2, Adj R^2) and regression coefficient (Unstandardized & standardized), t-value and Sig. value results. Findings were as shown in Table 4.28: Regression Results, Climate variability.

Table 4.28: Simple linear regression analysis on the influence of climate variability on smallholder farmers' activities

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.612a	.375	.372	.95260

a. Predictors: (Constant), Climate Variable

ANOVAa

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	130.118	1	130.118	143.390	.000b
	Residual	216.878	239	.907		
	Total	346.996	240			

a. Dependent Variable: Food Security

b. Predictors: (Constant), Climate Variable

Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.586	.224		20.457	.000
	Climate Variable	-.641	.054	-.612	-11.975	.000

a. Dependent Variable: Food Security

Table 4.28, the R value show the correlation coefficient between climate variability and household food security in West Pokot County. R=0.612 implies that there is significant relationship between climate variability and household food security in West Pokot County. The results revealed a coefficient of determination (r^2) of 0.375. Implying that climate variability can account up to 37.5 % of the variance in household food security in West Pokot County. The adjusted r square attempts to produce a more honest value to estimate r square for the population. The F test gave a value of (1, 240) = 143.390, P<0.01, which was large enough to support the goodness of fit of the model in explaining the variation in the dependent variable. It also means climate variability is a significant predictor of household food security in West Pokot County.

The results of coefficients in Table 4.28 also show that climate variability had a statistically significantly unique contribution in the prediction of the household food security in West Pokot County. Therefore, we reject our null hypothesis and conclude

that climate variability have a significant influence on the household food security in West Pokot County. Climate variability had a negative β coefficient = 0.641 an indication that a unit change in the climate variability is likely to lead to a reduction in the household food security in West Pokot County by 0.641 units. The model for this objective is as follows

Y_{hsf}=4.586 -0.641 X_4(Climate Variability)

Therefore, we conclude at 5% significance level that climate variability has a significant negative influence on the household food security in West Pokot County. It implies that, as number of hot days increase, rainfall amount reduces, increase in rainfall unpredictability, households in west Pokot are likely to suffer from reduce crop production, reduce livestock production implying that income is negatively affected. The household are also likely to suffer from diseases such as malaria, cholera and other tropical diseases. These results have been supported by a study by Boko *et al*,2007 that small holder farmers are the most vulnerable to weather variability with multiple stresses occurring at many levels, limiting their adaptive capacity.

4.10 Multiple Linear Regression Analysis

The general objective of this study is to establish the contribution of smallholder farmers on household food security in West Pokot County, Kenya. This was achieved by carrying out standard multiple regression models with the model consisting of climate variability, smallholder farming characteristics, socio-economic factors and household labor conditions. Prior to conducting multiple linear regressions, the assumptions of multiple linear regressions were tested. This included normality, linearity, multicollinearity, independence and Homoscedasticity.

4.10.1 Test of Independence (non-autocorrelation)

Independence of error terms, which implies that observations are independent, was assessed through the Durbin-Watson test. Durbin Watson (DW) test checked that the residuals of the models were not auto-correlated since independence of the residuals is one of the basic hypotheses of regression analysis (Montgomery *et al*, 2001). The results are as shown in Table 4.29.

Table 4.29: Autocorrelation Test for Regression

Std. Error of the Estimate	Durbin-Watson
.73079	1.837

Source: Field Data (2019)

From Table 4.29, the results of the study gave Durbin – Watson coefficient value 1.837 which is between 1.5 and 2.5 they indicated that there was no autocorrelation in the data residuals.

4.10.2 Multi-collinearity Test

Multi-collinearity is where two or more independent variables are highly correlated. When multi-collinearity increases, it makes the regression coefficient to fluctuate which complicates the interpretation of the coefficient as an indicator of predicting variables (Cooper & Schindler, 2011). Multi-collinearity was tested using variance inflation factors (VIF) or tolerance values. If VIF values are below 10 then rule of the thumb is there is no multi-collinearity problem or when the tolerance values have a value of one or less hence no multi-collinearity.

Table 4.30: Collinearity Statistics

Independent variable	Tolerance	VIF
Socio-economic Status	.728	1.374
Smallholder farming characteristics	.613	1.631
Household Labor Condition	.652	1.534
Climate Variability	.698	1.432

From the table 4.30 shows the Multicollinearity test was undertaken, whereby the tolerance ranged from 0.613 to 0.728 which are all above 0.2 and therefore it's reciprocal, the VIF was between 1.374 and 1.631, which are below the threshold value of 10 as required. This indicated that the data set displayed no multicollinearity.

4.10.3 Homoscedastic Test of Household Food Security

Homoscedastictest was carried out on household food security as shown below;

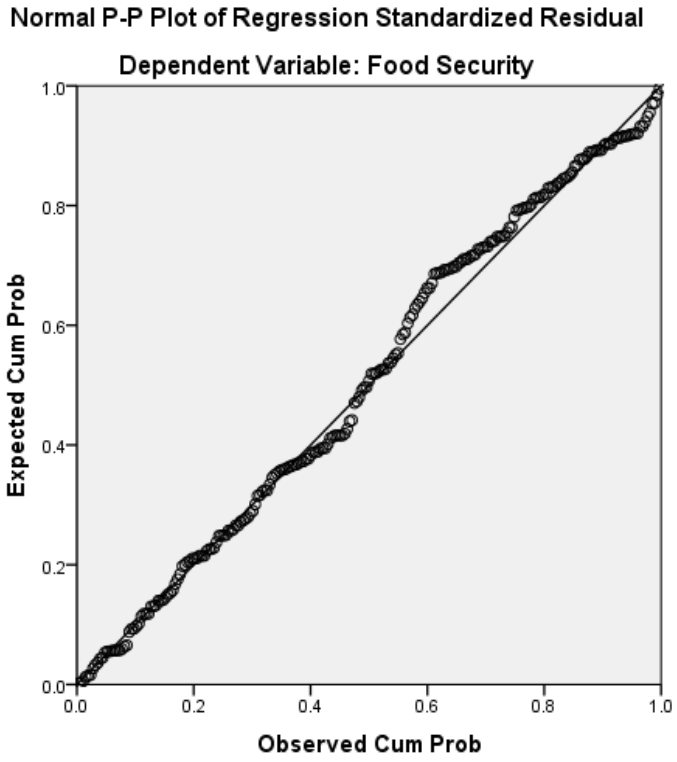

Figure 4.10: Homoscedastic Test of Household Food Security

Source: Field Data (2019)

From the figure 4.10, shows the results for homoscedasticity test whereby the independent variables are expected to have an equal variance, if not then there will be a heteroscedasticity problem (Garson, 2012). A test for homoscedasticity is a test for variance in residuals in a regression model. The probability – probability plot (P-P Plot) is homoscedasticity of data distribution (Park, 2008). The normal P-P plot of household food security shown in figure above shows that there is small deviation of the points from the straight line that cuts across the plane. This means that the data used in this research is homoscedastic hence the model adopted multiple linear regression model thus there is no problem of heteroscedasticity.

4.10.4 Normality test

Statistical errors are common in literature; many parametric procedures in correlation, regression, analysis of variance, and t-test are based on assumption of Gaussian or normal distribution. If this assumption do not hold it will be impossible to draw a reliable conclusion. With large samples (<30 or 40) the violation of normality assumption should not cause major problems (Ghasemi & Zahediasl 2012). Thus we can use parametric procedures as in large samples (<30 or 40) sampling distribution tend to be normal regardless of the shape of the data. Ghasemi & Zahediasl 2012) states that Kolmogorov-Smirnov test is a popular test for normality, but should be used with caution due to its low power and recommends that normality be assessed visually.

Table 4.31: Normality Test

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	**df**	**Sig.**	**Statistic**	**Df**	**Sig.**
Socio-economic Factors	.178	241	.000	.875	241	.000
Farming Characteristics	.216	241	.000	.901	241	.000
Household Labor Conditions	.203	241	.000	.898	241	.000
Climate Variability	.321	241	.000	.790	241	.000
Household Food Security	.265	241	.000	.776	241	.000

a. Lilliefors Significance Correction

From the Table 4.31 for all variables rejected their null hypotheses that the data sets for the five variables are not normally distributed when both Kolmogorov-Smirnov test and Shapiro-Wilk as the significance is< 0.05. Elliot and Woodward (2007), agree that parametric procedures can be used even when the data is not normally distributed. Ghasemi and Zahedias (2012) recommend that normality be assessed visually. Based on the figure below departure from normality was not much as from the approximation to the line of fit. Thus the regression residuals were near normal distribution and hence the assumption was met.

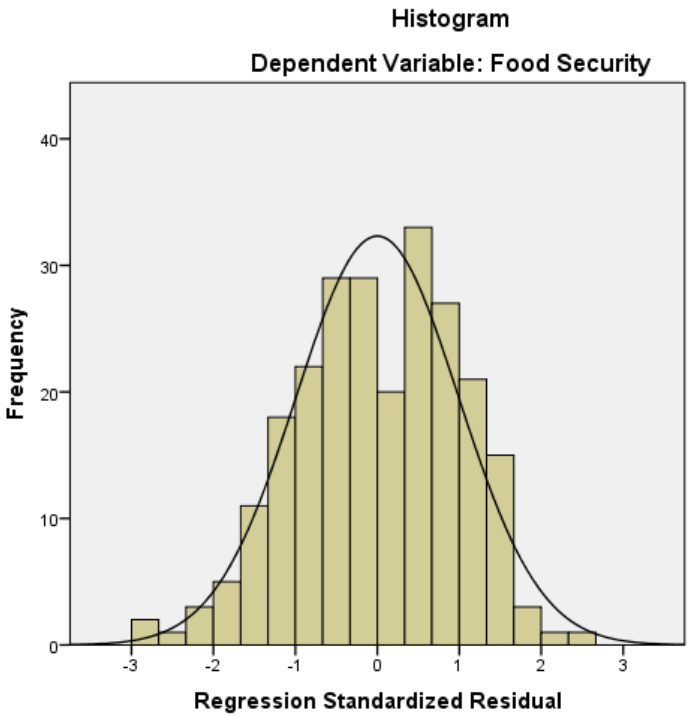

Figure 4.11: Normal Curve for Regression Residual

4.10.5 Linearity of the Variables

Linearity of the study variables was tested using Pearson's product moment correlation coefficient so as to show that independent variables had significant relationships with the dependent variable which were then considered prerequisite for running regression analysis. Therefore, the correlation analysis in table 4.9 shows that all independent

variables (Socio-economic factors, smallholder farming characteristics, and household labor condition and climate variability) had significant linear relationship with the dependent variable (Household food security).

Table 4.32: Linearity of the Variables

		SEF	SFC	HLC	CV	HSF
Social Economic Factor	Pearson Correlation	1	.458**	.401**	-.399**	.574**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	241	241	241	241	241
Smallholder Farming Characteristics	Pearson Correlation	.458**	1	.527**	-.466**	.649**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	241	241	241	241	241
Household Labor Conditions	Pearson Correlation	.401**	.527**	1	-.451**	.610**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	241	241	241	241	241
Climate Variability	Pearson Correlation	-.399**	-.466**	-.451**	1	-.612**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	241	241	241	241	241
Household Food Security	Pearson Correlation	.574**	.649**	.610**	-.612**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	241	241	241	241	241

****. Correlation is significant at the 0.01 level (2-tailed).**

4.10.6 The Study Model

Having met all the assumptions of multiple linear regressions, the study conducted multiple linear regressions to establish the influence of the study variables towards household food security. The influence was achieved using R square which is the coefficient of determination as the measures of smallholder farmers were entered as a block on the model. The results of multiple linear regression analysis was presented in

Table 4.10 which contained ANOVA (goodness of fit; F Ratio, Sig Value) and model summary (R, R2, Adj R2) results while Table 4.6 contained regression coefficient (Unstandardized & standardized), t-value and Sig. value results.

The study sought to determine the model summary findings in order to determine the overall percentage change in the household food security that was explained by all measures of small holder farming. The results in Table 4.10 present R, R2, Adj R2, F ratio and Sig. value.

Table 4.33: Multiple linear regression on the contribution of variables towards household food security

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.798a	.637	.631	.73079

a. Predictors: (Constant), CV, SEF, HLC, SFC

b. Dependent Variable: Food Security

ANOVAa

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	220.959	4	55.240	103.435	.000b
	Residual	126.037	236	.534		
	Total	346.996	240			

a. Dependent Variable: Food Security
b. Predictors: (Constant), CV, SEF, HLC, SFC

The results from Table 4.33 shows the information on the overall summary of the model. Looking at the R square column, the study deduced that all the measures of smallholder farming accounted for 63.7% significant variance in household food security in West Pokot County(R square =.637, P=0.000) implying that 36.3% of the variance in household food security in West Pokot County is accounted for by other variables not captured in this model. According to Cohen (1998), 63.7% of variation

explained by the model is regarded as large increase. From the findings, also adjusted R square value is obtained, which is a corrected R square value to provide a useful estimate of true study population. The difference between R2 and adjusted R2 is obtained by subtracting the later from the former (.637-.631=0.006) a value when multiplied by 100% results in 0.6 percent. This reduction implies that should the model originated from the entire population instead of a sample, it would explain about 0.6% less variation in the study outcome.

In order to assess the significance of the model, simply whether the study model is a better significant predictor of the household food security in West Pokot County rather than using mean score which is considered as a guess, the study resorted to F Ratio. The F value from study findings indicates the proportion of the improvement in predicting the results from fitting the model relative to the inaccuracy or errors that still prevails in the study model. From the findings, the F value is more than one, as indicated by a value of 103.435, which means that enhancement as a result of model fitting is much larger than the model errors/inaccuracies that were not used in the model (F(4,240)= 103.435, P=0.000). The large F value is very unlikely to exist by chance (99.0%), thus implying that the final study model has significant improvement in its prediction ability of household food security in West Pokot County.

The data presented in Table 4.34 shows unstandardized coefficients, standardized coefficients, t statistic and significant values.

Table 4.34: Unstandardized coefficients, standardized coefficients, t statistic and significant values.

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	1.099	.318		3.455	.001
SEF	.288	.056	.236	5.139	.000
SFC	.401	.070	.285	5.693	.000
HLC	.264	.053	.240	4.943	.000
CV	-.289	.049	-.277	-5.891	.000

a. Dependent Variable: Food Security

From the findings presented in Table 4.34, we look at the model results and scan down through the unstandardized coefficients B column. It can be noted that all the variables except climate variability (CV) had positive significant predictive power. If smallholding farming in West Pokot County is held at zero or it is absent, household food security would be significantly at 1.099, $p<0.05$.

The largest β coefficient was 0.401, which is coefficient value for smallholder farming characteristics. This values is significant (β=.401, p=.001) and also positive. This means that smallholder farming characteristics has the strongest unique contribution to explaining the household food security in West Pokot County, when the variance explained by all other variables in the model is controlled. A unit change in smallholder farming characteristics would result to significant change in household food security in West Pokot County by 0.401 units in the same direction.

Another variable that also had a unique significant contribution to the model was the value for socio-economic factors (β=.288, p=.000), slightly lower than smallholder farming characteristics. When other variables in the model are controlled, a unit change

in social economic factors would result to significant change in household food security in West Pokot County by 0.288 in the same direction. Further, household labor conditions had also a unique significant contribution to the model with β=.264, p=.000 implying that when other variables in the model are controlled, a unit change in household labor conditions would result to significant change in household food security in West Pokot County by 0.264 units in the same direction.

However, it was also noted that climate variability had a unique negative significant contribution to the model with β=-0.289, p=.000 suggesting that controlling of other variables in the model, a unit change in climate variability would result to significant change in household food security in West Pokot County by 0.289 in the opposite direction.

A regression of the four predictor variables against household food security established the multiple linear regression models as indicated in Table 4.34:

Household Food Security(Y) =1.099 + 0.288X_1+ 0.401X_2+ 0.264 X_3-0.289X_4

Where:

X_1= Socio-economic Factors
X_2 = Smallholding farming characteristics
X_3 = Household Labor Conditions
X_4 = Climate Variability

4.11 Moderated Multiple Regression

Further to the linear regression analysis, a hierarchical moderated multiple regression (MMR) was carried out to assess the moderating effect of farmer association on the influence of smallholder farming on household food security in the County. The MMR was adopted for the hierarchical stepwise analysis involved. According to Easterby-

Smith, *et al* 2008, the hierarchical MMR is a three-step analysis where a predictor or a set of predictors is added to the model at each stage and the effect on the overall model assessed. In stage one of the analysis, the hypothesized smallholder farming contribution was included in the model. In the second stage, the moderating variable was introduced to the model and the effect of the addition assessed. In the third stage to assess the moderating effect of moderating variable, the interaction terms between moderating variable and the smallholder farming were also introduced and the effect to the model assessed. The study was interested in establishing the change in R square (influence), change in Significance level (P) and the effect of the interaction on household food security in West Pokot County. This section will present five models moderated by farmers associations.

4.11.1 Moderating effect of Farmer Association on Socio-Economic Factors

Hierarchical moderated multiple regression (MMR) was carried out to examine how farmer association moderates socio-economic factors on smallholder farmers' influence to household food security in West Pokot County. In stage one of the analysis, the socio-economic factors latent variable was included in the model. In the second stage, the latent moderating variable was introduced to the model and the effect of the addition assessed. In the third stage to assess the moderating effect of moderating variable, the interaction terms between moderating latent variable and the socio-economic factors latent variable were also introduced and the effect to the model assessed.

Table 4.35: Hierarchical moderated multiple regression

Model	R	R^2	Adj. R^2	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.574[a]	.329	.327	.98676	.329	117.368	1	239	.000
2	.772[b]	.597	.593	.76684	.267	157.748	1	238	.000
3	.773[c]	.597	.592	.76823	.000	.135	1	237	.714

a. Predictors: (Constant), SEF
b. Predictors: (Constant), SEF, Farmers Association
c. Predictors: (Constant), SEF, Farmers Association, SEF*Farmer Association
d. Dependent Variable: Food Security

The summary statistics show the effect of each stage of the analysis in Table 4.35. The study assessed the change statistics including the change in R-square and the change on F-statistics as the effect at each stage. In model 1, the R-square of 0.329 shows that 32.9% of the variation in the dependent variable (household food security) is explained by the variation of the predictors (socio-economic factors) in model 1. Model 2 shows an R-square of 0.617. The R-square change is 0.267 (26.7%) as the increase due to introduction of the moderating variable (farmer association). The change is significant at 5% level of significant as portrayed by the p-value of the change in R-square of 0.267 which is less than 0.05. This is an implication that the change in the model due to the addition of the variable farmer association has significant effect to the model. In stage 3, the interaction terms between socio-economic factors and the moderator were added to the model and the effect assessed. The R-square of the third model is 0.597. The R-square change due to the introduction of the interaction terms is 0.000. The change is insignificant at 5% level of significance as implied by the p-value of the F-statistics for model 3 which is greater than 0.05. The insignificant improvement to the model due to introduction of the interaction terms is an indication that farmer association does not

moderate the relationship between the socio-economic factors and household food security.

4.11.2 Moderating effect of Farmer Association on Smallholder farming characteristics

Hierarchical moderated multiple regression (MMR) was carried out to evaluate how farmer association moderates smallholder farming characteristics in West Pokot County. In stage one of the analysis, the smallholding farmer characteristics latent variable was included in the model. In the second stage, the latent moderating variable was introduced to the model and the effect of the addition assessed. In the third stage to assess the moderating effect of moderating variable, the interaction terms between moderating latent variable and the smallholder farming characteristic latent variable was entered and the effect to the model observed.

Table 4.36: Hierarchical moderated multiple regression

Model	R	R^2	Adj. R^2	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.649[a]	.421	.419	.91649	.421	174.113	1	239	.000
2	.838[b]	.703	.700	.65846	.281	225.012	1	238	.000
3	.880[c]	.774	.771	.57531	.071	74.772	1	237	.000

a. Predictors: (Constant), SFC
b. Predictors: (Constant), SFC, Farmers Association
c. Predictors: (Constant), SFC, Farmers Association, SFC*Farmer Association
d. Dependent Variable: Food Security

The summary statistics show the effect of each stage of the analysis in Table 4.36. In model 1, the R-square of 0.421 shows that 42.1% of the variation in the dependent variable (household food security) is explained by the variation of the predictors (smallholder farmer characteristics) in model 1. Model 2 reveals an R-square of 0.703.

The R-square change is 0.281 as the increase due to introduction of the moderating variable (farmer association). The change is significant at 5% level of significant as depicted by the p-value of the change in R-square of 0.281 which is less than 0.05. This is an implication that the change in the model due to the addition of farmer association latent variable has significant effect to the model. In stage 3, the interaction terms between stallholder farming characteristics and the moderator were added to the model and the effect assessed. The R-square of the third model is 0.774 implying that 77.4% of the variation in household food security is explained by the variation of the predictors in model 3. The R-square change due to the introduction of the interaction terms is 0.071. The change is significant at 5% level of significance as implied by the p-value of the F-statistics for model 3 which is less than 0.05. The significant improvement to the model due to introduction of the interaction terms is an indication that farmer association moderates the relationship between the smallholder farming characteristics and household food security. Table 4.37 shows the coefficient estimates of the 3 MMR models.

Table 4.37: Coefficient estimates of the 3 MMR models.

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	Sig.
		B	**Std. Error**	**Beta**		
1	(Constant)	.019	.162		.117	.907
	Farming Characteristics	.912	.069	.649	13.195	.000
2	(Constant)	.199	.117		1.708	.089
	Farming Characteristics	.581	.054	.413	10.689	.000
	Farmer Association (FA)	.508	.034	.580	15.000	.000
3	(Constant)	.531	.109		4.875	.000
	Farming Characteristics (X_2)	.340	.055	.242	6.174	.000
	Farmer Association (Z)	-.329	.101	-.376	-3.249	.001
	Farming Characteristics*FA(X_2Z)	1.006	.116	1.071	8.647	.000

a. Dependent Variable: Food Security

The coefficients of model 1 were positive and significant. The addition of farmer association to the model had significant to the model. The added variable farmer association (β= .508, p = .000) has a p-value less than 0.05 implying that in model 2, farmer association have significant direct influence on household food security. Model 3 that saw the addition of the interaction terms of smallholder farming characteristics and farmer association (β= 1.006, p = .000) has p-values less than 0.05 implying significant influence. The result of model 3 therefore shows that farmer association has a significant moderating effect on the relationship between smallholder farmer characteristics and household food security. This implies that, as farmer association increases by one unit, the level of smallholder farming characteristics effect on household food security significantly increases by 1.006 units. The model for the estimate of household food security as generated from the MMR model 3 is given by the equation below;

$$\mathbf{Y = 0.531 + 0.340X_2 - 0.329Z + 1.006X_2Z}$$

4.11.3 Moderating effect of Farmer Association on Household Labor conditions

Hierarchical moderated multiple regression was conducted to analyze how farmer association moderates smallholder farmers household labor conditions in West Pokot County. In stage one of the analysis, the household labor conditions latent variable was included in the model. In the second stage, the latent moderating variable was introduced to the model and the effect of the addition assessed. In the third stage to assess the moderating effect of moderating variable, the interaction terms between moderating latent variable and the household labor condition latent variable was entered and the effect to the model assessed.

Table 4.38: Hierarchical moderated multiple regression

Model	R	R^2	Adj. R^2	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.610[a]	.372	.370	.95466	.372	141.738	1	239	.000
2	.803[b]	.645	.642	.71964	.273	182.599	1	238	.000
3	.828[c]	.685	.681	.67910	.040	30.262	1	237	.000

a. Predictors: (Constant), HLC
b. Predictors: (Constant), HLC, Farmers Association
c. Predictors: (Constant), HLC, Farmers Association, HLC *Farmer Association
d. Dependent Variable: Food Security

In model 1 from Table 4.38, the R-square of 0.372 shows that 37.2% of the variation in the dependent variable (household food security) is explained by the variation of the predictors (Household labor condition) in model 1. Model 2 indicates an R-square of 0.643. The R-square change is 0.273 as the increase due to introduction of the moderating variable (farmer association). The change is significant at 5% level of significant as portrayed by the p-value of the change in R-square of 0.273 which is less than 0.05. This is an insinuation that the change in the model due to the addition of farmer association latent variable has significant effect to the model. In stage 3, the interaction terms between household labor conditions and the moderator were included in the model and the effect assessed. The R-square of the third model is 0.685 implying that 68.5% of the variation in household food security is explained by the variation of the predictors in model 3. The R-square change due to the introduction of the interaction terms is 0.040. The change is significant at 5% level of significance as implied by the p-value of the F-statistics for model 3 which is less than 0.05. The significant improvement to the model due to introduction of the interaction terms is an indication that farmer association moderates the relationship between the household labor

conditions and household food security. Table 4.39 shows the coefficient estimates of the 3 MMR models;

Table 4.39: Coefficient estimates of the 3 MMR models;

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.491	.141		3.475	.001
	Household Labor Condition	.670	.056	.610	11.905	.000
2	(Constant)	.640	.107		5.979	.000
	Household Labor Condition	.377	.048	.344	7.919	.000
	Farmer Association (FA)	.619	.046	.586	13.513	.000
3	(Constant)	.886	.110		8.020	.000
	Household Labor Condition (X_3)	.206	.055	.188	3.773	.000
	Farmer Association (Z)	-.147	.146	-.139	-1.008	.315
	Household Labor*FA(X_3Z)	.810	.147	.833	5.501	.000

a. Dependent Variable: Food Security

The coefficient of model 1 was positive and significant as indicated earlier. The addition of farmer association to the model had significant to the model. The added latent variable farmer association (β= .619, p = .000) has a p-value less than 0.05 implying that in model 2, farmer association have significant direct influence on household food security. Model 3 regarded the addition of the interaction terms of household labor condition and farmer association (β= 0.810, p = .000) has p-values less than 0.05 suggesting significant influence. The result of model 3 therefore shows that farmer association has a significant moderating effect on the relationship between household labor condition and household food security. This means that, as farmer association increases by one unit, the level of household labor conditions effect on household food security significantly increases by 0.810 units. The model for the

estimate of household food security as generated from the MMR model 3 is given by the equation below;

$$Y = 0.886 + 0.206X_3 - 0.147Z + 0.810X_3Z$$

4.11.4 Moderating effect of Farmer Association on Climate Variability

Hierarchical moderated multiple regression was conducted to determine how farmer association moderates the influence of climate variability on smallholder farmers activities towards achieving household food security in West Pokot County. In stage one of the analyses; the climate variability latent variable was included in the model. In the second stage, the latent moderating variable was introduced to the model and the effect of the addition assessed. In the third stage to assess the moderating effect of moderating variable, the interaction terms between moderating latent variable and the climate variability latent variable was entered and the effect to the model assessed.

Table 4.40: Hierarchical moderated multiple regression

Model	R	R^2	Adj. R^2	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.612[a]	.375	.372	.95260	.375	143.390	1	239	.000
2	.748[b]	.559	.555	.80192	.184	99.255	1	238	.000
3	.862[c]	.743	.740	.61343	.184	169.735	1	237	.000

a. Predictors: (Constant), CV
b. Predictors: (Constant), CV, Farmers Association
c. Predictors: (Constant), CV, Farmers Association, CV*Farmer Association
d. Dependent Variable: Food Security

In model 1 from Table 4.40, the R-square of 0.372 shows that 37.2% of the variation in the dependent variable (household food security) is explained by the variation of the predictors (Climate variability) in model 1. Model 2 shows an R-square of 0.559. The R-square change is 0.184 as the increase due to introduction of the moderating variable (farmer association). The change is significant at 5% level of significant as portrayed

by the p-value of the change in R-square of 0.184 which is less than 0.05. This is an insinuation that the change in the model due to the addition of farmer association latent variable has significant effect to the model. In stage 3, the interaction terms between climate variability and the moderator were included in the model and the effect observed. The R-square of the third model is 0.743 implying that 74.3% of the variation in household food security is explained by the variation of the predictors in model 3. The R-square change due to the introduction of the interaction terms is 0.184. The change is significant at 5% level of significance as implied by the p-value of the F-statistics for model 3 which is less than 0.05. The significant improvement to the model due to introduction of the interaction terms is an indication that farmer association moderates the relationship between the climate variability and household food security. Table 4.41 shows the coefficient estimates of the 3 MMR models.

Table 4.41: Coefficient estimates of the 3 MMR models

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.586	.224		20.457	.000
	Climate variability	-.641	.054	-.612	-11.975	.000
2	(Constant)	3.507	.218		16.119	.000
	Climate variability	-.482	.048	-.460	-10.083	.000
	Farmer Association (FA)	.397	.040	.455	9.963	.000
3	(Constant)	1.656	.219		7.567	.000
	Climate variability (X_3)	-.092	.047	-.088	-1.940	.054
	Farmer Association (Z)	-.726	.091	-.832	-7.941	.000
	Climate Variability*FA(X_3Z)	1.442	.111	1.517	13.028	.000

a. Dependent Variable: Food Security

The coefficient of model 1 was negative and significant as indicated from simple linear regression. The addition of farmer association to the model had significant to the model. The added latent variable farmer association (β= .397, p = .000) has a p-value less than

0.05 implying that in model 2, farmer association have significant direct influence on household food security as far climate variability is concerned. Model 3 considers the addition of the interaction terms of climate variability and farmer association (β= 1.442, p = .000) has p-values less than 0.05 suggesting a positive significant influence. The result of model 3 therefore shows that farmer association has a significant moderating effect on the relationship between climate variability and household food security. This means that, as farmer association increases by one unit, the level of climate variability effect on household food security significantly decreases by 1.442 units.

The model for the estimate of household food security as generated from the MMR model 3 is given by the equation below;

$$\mathbf{Y = 1.656 - 0.092X_4 - 0.726Z + 1.442X_4Z}$$

4.10.5 Moderating Effect of Farmer Association on the four independent Variables

A hierarchical moderated multiple regression (MMR) was carried out to assess the moderating effect of farmer associations on the four independent variables. The MMR was adopted for the hierarchical stepwise analysis involved. The hierarchical MMR is a four-step analysis where a predictor or a set of predictors is added to the model at each stage and the effect on the overall model assessed. In stage one of the analysis, the control variables (age, gender, level of education, marital status and is household head) were included in the model. In the second stage, the four independent variables were added in the model and the effect assessed. In the third stage, the moderating variables were introduced to the model and the effect of the addition assessed. In the fourth stage to assess the moderating effect of moderating variable, the interaction terms between moderating variable and the smallholder farming variables were also introduced and

the effect to the model assessed. The results are presented in a series of four steps as follows

Step 1: Inclusion of Control Variables

The first step was to establish relationship between control variables and the household food security. The control variables of age, gender, level of education, marital status and is household head were selected and entered as independent variables in the SPSS analysis tool, and household food security was entered as a dependent variable. The results were as indicated in Table 4.42.

Table 4.42: Results of the relationship between control variables and household food security.

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	Std. Error	Beta		
1	(Constant)	2.646	.577		4.586	.000
	Gender	-.081	.171	-.033	-.471	.638
	Age	-.040	.080	-.042	-.497	.620
	Education	-.044	.064	-.050	-.689	.492
	Marital Status	.011	.112	.008	.103	.918
	Household Head	-.228	.186	-.089	-1.228	.221
	R	0.089				
	R^2	0.008				
	Adjusted R^2	-0.013				
	R^2 change	0.008				
	F change	0.376				0.865
	Df	5,235				

From Table above, the control variable had insignificant contribution to household food security as indicated by P=0.865 which implies that 8.9% (R^2=0.089) that contributes to household food security is insignificant. The Beta coefficients were also not significant as indicated by gender (β=-0.081, P=0.638), age (β=-0.040, P=0.620),

education (β=-0.044, P=0.492), marital status (β=0.011, P=0.918) and household head (β=-0.228, P=0.221).

Step 2: Independent Variables in the Model

The second step was to establish relationship between independent variables and the household food security. The independent variables of socio-economic factors, smallholder farming characteristics, and household labor condition and climate variability were selected and entered as independent variables in the SPSS analysis tool, and household food security was entered as a dependent variable. The results were as indicated in Table 4.43.

Table 4.43: Results of relationship between the study independent variables and household food security.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
2	(Constant)	2.089	.471		4.438	.000
	Gender	-.192	.103	-.079	-1.868	.063
	Age	-.119	.048	-.125	-2.485	.014
	Education	-.038	.039	-.043	-.983	.326
	Marital Status	.027	.068	.020	.401	.689
	Household Head	-.171	.111	-.067	-1.543	.124
	Socio-economic Factors	.292	.056	.239	5.184	.000
	Farming characteristics	.407	.070	.290	5.831	.000
	Household Labor	.263	.054	.239	4.907	.000
	Climate Variability	-.300	.049	-.286	-6.105	.000
	R	0.809				
	R^2	0.654				
	Adjusted R^2	0.641				
	R^2 change	0.646				
	F change	107.906				
	Df	4,231				

From Table 4.43, the results showed R^2 change by 0.646 (64.6%) from 0.089 (8.9%) to 0.654 (65.4%). The F change was significant (107.906, P<0.001). This implies that after controlling age, gender, education, household head and marital status, smallholder

farming contributes 64.4% of household food security. The Beta coefficients were also significant as indicated by socio-economic factors (β=0.292, P=0.000), farming characteristics (β=0.407, P=0.000), household labor condition (β=0.263, P=0.000) and climate variability (β=-0.300, P=0.000).

Step 3: Independent Variables in the Model

The third step was to establish relationship between the moderator variables (Farmer Association) and the household food security. The results were as shown Table 4.44.

Table 4.44: Results of the relationship between the moderator variables

Model		**Unstandardized Coefficients**		**StandardizedT Coefficients**		**Sig.**
		B	**Std. Error**	**Beta**		
	(Constant)	1.212	.360		3.369	.001
	Gender	-.027	.078	-.011	-.341	.733
	Age	-.054	.037	-.056	-1.457	.147
	Education	-.046	.029	-.052	-1.553	.122
	Marital Status	-.017	.052	-.012	-.320	.749
	Household Head	-.107	.084	-.042	-1.274	.204
	Socio-economic Factors	.152	.045	.125	3.376	.001
3	Farming characteristics	.280	.054	.199	5.215	.000
	Household Labor	.156	.042	.142	3.679	.000
	Climate Variability	-.169	.039	-.161	-4.364	.000
	Farmer Association (SEF)	.202	.056	.168	3.622	.000
	Farmer Association (SFC)	.153	.055	.175	2.778	.006
	Farmer Association (HLC)	.159	.065	.151	2.457	.015
	Farmer Association (CV)	.076	.044	.088	1.752	.081
	R	0.900				
	R^2	0.809				
	Adjusted R^2	0.798				
	R^2 change	0.155				
	F change	46.061				
	Df	4,227				

From Table 4.44, the results showed R^2 change by 0.155 (15.5%) from 0.654 (65.4%) to 0.809 (80.9%). The F change was significant (46.061, P<0.001). This implies that farming association contributes 15.5% of household food security. Apart from famer association (Climate Change), the other Beta coefficients were also significant as

indicated by Farmer Association (socio-economic factors) (β=0.202, P=0.000), Farmer Association (farming characteristics) (β=0.153, P=0.006) and Farmer Association (household labor condition) (β=0.159, P=0.015). Climate change has insignificant Beta Coefficient Farmer Association (climate variability) (β=0.074, P=0.081).

Step 4: Independent Variables in the Model

The third step was to establish relationship between the cross interaction of farmer association and small holder farming on the household food security. The cross interaction was achieved by cross multiplying farmer association metrics and independent variables. This included Farmer Association * Socio-economic Factors (FA*SEF), Farmer Association * Smallholder farmer characteristics (FA*SFC), Farmer Association * Household labor conditions (FA*HLC) and Farmer Association * climate variability (FA*CV). The results variable was then standardized using mean centering to avoid problem of multicollinearity where two variables are highly correlated. The analysis sought to test the following null hypotheses.

H_{05a}: There is no significant moderating influence of farmer association on the relationship between smallholder socio-economic factors and household food security in West Pokot County.

H_{05b}: There is no significant moderating influence of farmer association on the relationship between smallholder farming characteristics and household food security in West Pokot County.

H_{05c}: There is no significant moderating influence of farmer association on the relationship between farmers' household labor conditions and household food security in West Pokot County.

H_{05d}: There is no significant moderating influence of farmer association on the relationship between climate variability and household food security in West Pokot County.

The results were as shown Table 4.45.

Table 4.45: Results of the relationship between the cross interaction of farmer association and small holder farming on the household food security

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
4	(Constant)	1.118	.326		3.426	.001
	Gender	-.006	.066	-.002	-.091	.928
	Age	-.057	.031	-.060	-1.843	.067
	Education	-.052	.025	-.060	-2.112	.036
	Marital Status	.023	.044	.017	.522	.602
	Household Head	-.073	.071	-.029	-1.029	.305
	Socio-economic Factors	-.065	.154	-.054	-.425	.672
	Farming characteristics	.171	.054	.122	3.194	.002
	Household Labor	.101	.045	.092	2.213	.028
	Climate Variability	-.080	.039	-.076	-2.033	.043
	Farmer Association (SEF)	-.048	.183	-.040	-.262	.794
	Farmer Association (SFC)	-.239	.091	-.274	-2.644	.009
	Farmer Association (HLC)	-.079	.112	-.075	-.704	.482
	Farmer Association (CV)	-.352	.077	-.404	-4.600	.000
	FA*SEF	.334	.332	.232	1.004	.317
	FA*SFC	.569	.135	.606	4.204	.000
	FA*HLC	.128	.128	.132	1.000	.318
	FA*CV	.549	.113	.577	4.881	.000
	R	0.931				
	R^2	0.867				.000
	Adjusted R^2	0.857				
	R^2 change	0.058				
	F change	24.169				
	Df	4,223				

The F-statistic was significant at $p<0.001$ ($F=24.169$). This implies that there existed a statistical relationship between the interaction (predictor) and household food security (criterion) variables, either directly or indirectly. The coefficient of determination R^2 from the model was 0.857, P=0.000 meaning that the interaction terms (Smallholder farming with farmer association variables) accounted 85.7% of the variation in household food security.

From Beta coefficients, farmer associations have insignificant moderating effect on the relationship between socio-economic factors and household food security as shown by $\beta=0.334$, P=0.317. This means that, as participation of farmers association increases by one unit, the level of socio-economic factors effect on household food security insignificantly increases by 0.334 units. However, farmer associations have significant moderating effect on the relationship between smallholder farming characteristics and household food security as shown by $\beta=0.569$, P=0.000. This means that, as participation of farmers association increases by one unit, the level of smallholder farming characteristic effect on household food security significantly increases by 0.569 units.

Farmer associations have insignificant moderating effect on the relationship between household labor condition and household food security as shown by $\beta=0.128$, P=0.318. This means that, as participation of farmers association increases by one unit, the level of household labor condition effect on household food security insignificantly increases by 0.128 units. However, farmer associations have significant moderating effect on the relationship between climate variation and household food security as shown by $\beta=0.549$, P=0.000. This means that, as participation of farmers association increases by

one unit, the level of climate variable effect on household food security significantly increases by 0.549 units.

Table 4.46: ANOVA Results

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2.757	5	.551	.376	.865[b]
	Residual	344.238	235	1.465		
	Total	346.996	240			
2	Regression	226.990	9	25.221	48.548	.000[c]
	Residual	120.006	231	.520		
	Total	346.996	240			
3	Regression	280.754	13	21.596	74.008	.000[d]
	Residual	66.241	227	.292		
	Total	346.996	240			
4	Regression	300.787	17	17.693	85.387	.000[e]
	Residual	46.208	223	.207		
	Total	346.996	240			

a. Dependent Variable: Food Security
b. Predictors: (Constant), Household Head, Education, Gender, Age, Marital Status
c. Predictors: (Constant), Household Head, Education, Gender, Age, Marital Status, SFC, SEF, CV, HLC
d. Predictors: (Constant), Household Head, Education, Gender, Age, Marital Status, SFC, SEF, CV, HLC, FA(CV), FA(SEF), FA(HLC), FA(SFC)
e. Predictors: (Constant), Household Head, Education, Gender, Age, Marital Status, SFC, SEF, CV, HLC, FA(CV), FA(SEF), FA(HLC), FA(SFC), FA*CV, FA*HLC, FA*SFC, FA*SEF

The overall results in table 4.46 show the F values were 48.548, 74.008 and 85.387 ($p<0.001$) for steps 2, 3 and 4. This therefore means that the interactions of small holder farming contribution (Socio-economic status, smallholder farming practices, and household labor condition and climate variability) with farmer association were predictors of household food security. The model was found to be statistically significant, $F(17, 240) = 85.387$, $p<0.001$; and therefore fit in predicting household food security using the interaction of influence of smallholder farming and farmer association.

4.11.6 Graphical Presentation of the moderating Effect of Farmer Association

Farmer association was therefore found to moderate the relationships between household food security and two smallholder farming contributions (SFC & CV). Graphical presentation of the moderating influence was therefore constructed for the 2 effects.

Figure below shows a graphical presentation of the moderating effect of farmer association on the relationship between farming characteristics and household food security in West Pokot County. As shown, low levels of farmer association show a gradual slope which is due to the existence of a causal relationship between smallholder farming characteristics and household food security in West Pokot County. Increasing the levels of farmer association shows an increase in the slope of the curve between smallholder farming characteristics and food security in West Pokot County. The slope keeps increasing at higher levels of farmer association implying that increasing the level of farmer association has a positive moderating effect which increases the strength of the causal relationship between Smallholder farming characteristics and household food security in West Pokot County.

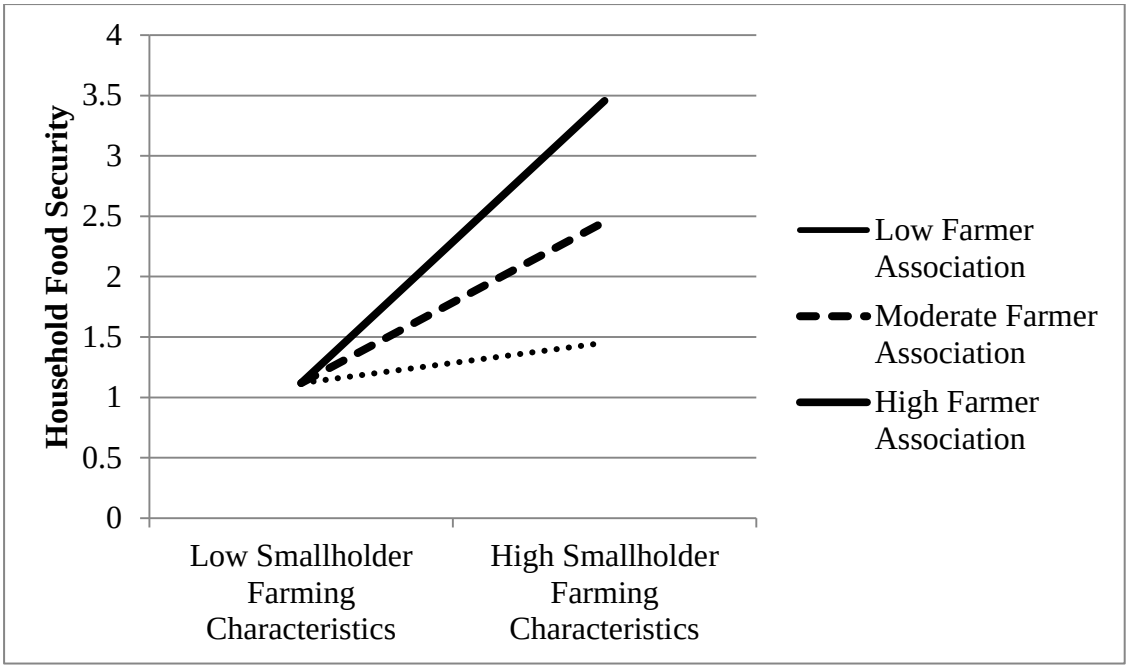

Figure 4.12: Moderating effect of Farmer Characteristics on household food security and smallholder farmer association

Figure 4.12 shows a graphical presentation of the moderating effect of farmer association on the relationship between climate variability and household food security in West Pokot County. As shown, low levels of farmer association show a gradual slope which is due to the existence of a causal relationship between climate variability and household food security in West Pokot County. Increasing the levels of farmer association shows an increase in the slope of the curve between climate variability and food security in West Pokot County. The slope keeps increasing at higher levels of farmer association implying that increasing the level of farmer association has a positive moderating effect which increases the strength of the causal relationship between climate variability and household food security in West Pokot County.

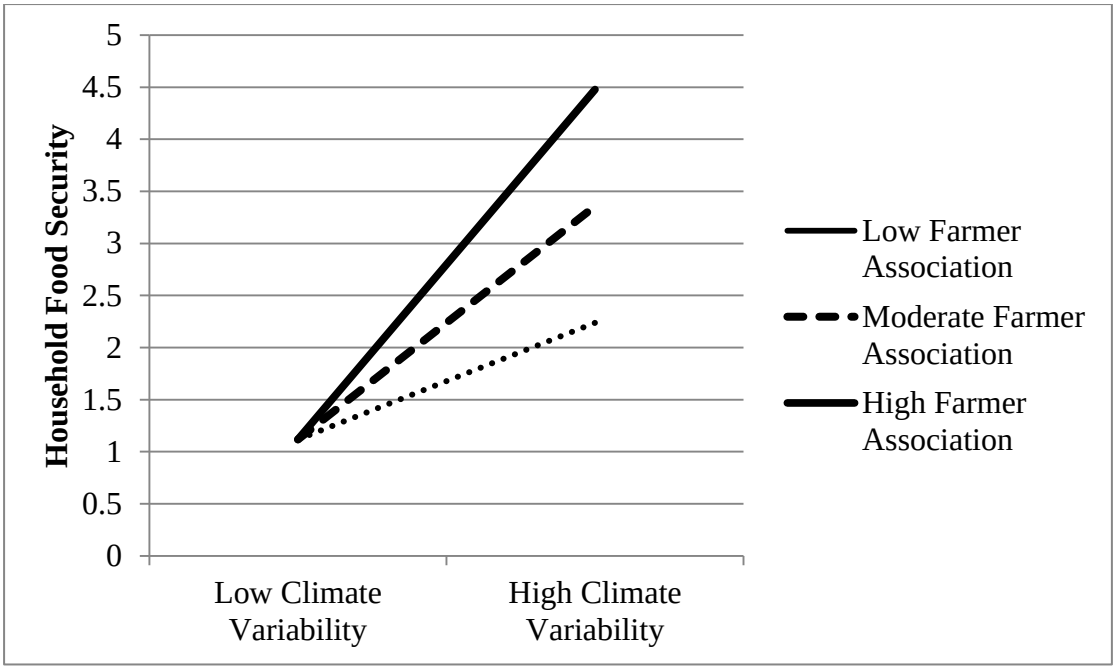

Figure 4.13: Moderating effect of Climate variability on household food security and farmer association.

4.11.7 Hypothesis Testing

The moderated regression analysis results in table 4.20 were used to test the four (4) hypotheses that were anchored on the interaction of farmer association and smallholder farming.

H_{05a}: There is no significant moderating influence of farmer association on the relationship between smallholder socio-economic factors and household food security in West Pokot County.

The Beta coefficient for the interaction (FA*SEF) was positive and significant at B=0.334 (p>0.05). Therefore the null hypothesis was rejected and it was concluded that there is no significant moderating influence of farmer association on the relationship between smallholder socio-economic factors and household food security in West Pokot County.

H_{05b}: There is no significant moderating influence of farmer association on the relationship between smallholder farming characteristics and household food security in West Pokot County.

The Beta coefficient for the interaction (FA*SFC) was positive and significant at B=0.569 ($p<0.05$). Therefore the null hypothesis was rejected and it was concluded that there is significant moderating influence of farmer association on the relationship between smallholder farming characteristics and household food security in West Pokot County.

H_{05c}: There is no significant moderating influence of farmer association on the relationship between farmers' household labor conditions and household food security in West Pokot County.

The Beta coefficient for the interaction (FA*HLC) was positive and significant at B=0.128 ($p>0.05$). Therefore the null hypothesis was accepted and it was concluded that there is no significant moderating influence of farmer association on the relationship between household labor condition and household food security in West Pokot County.

H_{05d}: There is no significant moderating influence of farmer association on the relationship between climate variability and household food security in West Pokot County.

The Beta coefficient for the interaction (FA*SFC) was positive and significant at B=0.549 ($p<0.05$). Therefore the null hypothesis was rejected and it was concluded that there is significant moderating influence of farmer association on the relationship between climate variability and household food security in West Pokot County.

Table 4.47: Summary of the hypotheses testing results

	Hypotheses	**Results**
$H_{01:}$	Socio-economic Factors (SEF)→Household Food Security	Accepted
$H_{02:}$	Smallholder farming characteristics(SFC)→Household Food Security	Accepted
$H_{03:}$	Household labor condition (HLC)→Household Food Security	Accepted
$H_{04:}$	Climate Variability (CV)→Household Food Security	Accepted
H_{05a}:	SEF*FA→Household Food Security	Rejected
H_{05b}:	SFC*FA→Household Food Security	Accepted
H_{05c}:	HLC*FA→Household Food Security	Rejected
H_{05d}:	CV*FA→Household Food Security	Accepted

The table 4.47 shows a summary of hypothesis testing discussed above.

CHAPTER FIVE

SUMMARY, DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview

This chapter covers the summary of findings, conclusions from the study, theoretical and managerial implications, limitations of the study and suggestions for further research.

5.1 Summary of the Study Findings

The study was premised on the relationship between household food security and socio-economic factors, smallholder farming characteristics, household labor conditions, climate variability; and also when this relationship is moderated by farmer association. A conceptual framework was developed and was tested empirically. From the conceptual framework, the study developed 9 models. The analysis covered description and characteristics of respondents, responses and measures of the study variables.

A multi-variate moderated regression analysis was undertaken. The hypotheses were tested to address the following specific study objectives:- to examine the role of socio-economic factors on smallholder farmers contribution to household food security in West Pokot County, to evaluate smallholder farming characteristics on household food security in West Pokot County, to analyses the role of farmers household labor conditions on household food security in West Pokot County, to determine the influence of climate variability on smallholder farmers activities towards achieving household food security in West Pokot County, to establish how farmer association as a moderating variable influence the relationship between smallholder farming and household food security in West Pokot County, to examine how farmer association moderates socio-economic factors on smallholder farmers' contribution to household food security in West Pokot County, to evaluate how farmer association moderates smallholder farming characteristics in West Pokot County, to analyze how farmer

association moderates smallholder farmers household labor conditions in West Pokot County and to determine how farmer association moderates the influence of climate variability on smallholder farmers activities towards achieving household food security in West Pokot County.

The first objective of the study was to examine the role of socio-economic factors on smallholder farmer's contribution to household food security in West Pokot County. The findings indicated majority of the sampled farmers earned less than Ksh. 20,000 with 41.5% earning less than 10,000 and 37.8% earning between Ksh 10,000 and 20,000. It was further revealed that majority of the respondents 61.8% spent less than 10,000 in farming with 31.1% spending less than Ksh. 5,000 and 30.7% spending between Ksh. 5001 and 10,000. The results revealed that on average, household in West Pokot spent 50.1% of their income on farming although there were extreme cases where some household spent 5.0% and other spent 100% of their income. Most of the household income was spent on tilling/Ploughing of land while least percentage was used in marketing. Some household did not use any percentage of their income on marketing, input purchase, storage, harvesting and planting.

The second objective of the study was to evaluate smallholder farming characteristics on household food security in West Pokot County. The characteristics were informed by farm size, farming practices such as application of fertilizers and manure, use of improved seeds, type of food crops, number of cultivation per season and mixed farming practices. The findings revealed that 79.7% of the sampled households have their household land size less than 3.0 hectare although 7.9% had between 4 and 5 hectares. On the other hand, it was noted that 70.2% of the respondents cultivated less than 2 hectares with 32.4% cultivating less than 1.0 hectares. It can be deduced that

most of the sampled households, did not utilized the available land for food production. A correlation was established between total arable land available and arable land under food production as indicated by R=0.570.

The third objective of the study was to analyze the role of farmers' household labour conditions on household food security in West Pokot County. Household labour condition in this study was conceptualized as the number of hours men and women member of household spent on their farms per day, task performed by men and household members of the family as well as utilization of the labour in the farm apart from household labour.

Majority of the household had between 2 and 7 household members of which between 2 and 4 were 29.9% while between 5 and 7 were 36.5% of the sampled household. From the total number of household, 45.2% of the respondents indicated that one of their male household members participated in the farm labour as compared 41.1% of female household members. The results further revealed that between 2 and 3 male members were 41.1% of the household members while for female it was 45.2% of female members. There was no significant different between 6 and 7 members and over 7 household members for both gender. This was further supported by independent t-test where there no significant difference between male and female hours spent on farm as indicated by mean difference of -.04979, C.I=-0.20560-0.10601, P=0.530.

The fourth objective of the study was to determine the influence of climate variability on smallholder farmer's activities towards achieving household food security in West Pokot County. Climate variability was determined based on the significant change in whether over last 20 years, the impact of these changes to local community, adjustment

done in relation to climate variability and organizations involved to address effect of climate variability.

Majority of the respondents indicated that there is significant change in rainfall pattern as shown by 63.1% of the respondents over the last 20 years. This was associated with prolong drought and to some extent very hot seasons. Only 2.5% indicated that there have been incidences of very wet seasons. The number of hot day have been increasing over the last 20 years as indicated by 73.0% of the respondents whole only 1.7% of the respondents indicating they have been declining. The number of rainfall over the last twenty years has declined as indicated by 58.5%. Another significant change related with rainfall is that there has been changes in timing as shown by 41.9% and change in the frequency of drought and flood as indicated by 35.5% of the sampled household respondents.

The fifth objective of the study was to establish how farmer association as a moderating variable influences the relationship between smallholder farming and household food security in West Pokot County. This was a composite objective which was further divided into four sub objectives which include to examine how farmer association moderates socio-economic factors on smallholder farmers' contribution to household food security in West Pokot County, evaluate how farmer association moderates smallholder farming characteristics in West Pokot County, to analyze how farmer association moderates smallholder farmers household labour conditions in West Pokot County and to determine how farmer association moderates the influence of climate variability on smallholder farmers activities towards achieving household food security in West Pokot County. The results indicated that less than half of the sampled

respondents had membership in various group/association that aid in farming activities as indicated by 47.3%.

5.2 Discussions of the Findings

5.2.1 Socio-economic factors that influence household food security

The first objective of the study was to examine the role of socio-economic factors on smallholder farmer's contribution to household food security in West Pokot County. The findings indicated majority of the sampled farmers earned less than Ksh. 20,000 with 41.5% earning less than 10,000 and 37.8% earning between Ksh 10,000 and 20,000. It was further revealed that majority of the respondents 61.8% spent less than 10,000 in farming with 31.1% spending less than Ksh. 5,000 and 30.7% spending between Ksh. 5001 and 10,000. The results revealed that on average, household in West Pokot spent 50.1% of their income on farming although there were extreme cases where some household spent 5.0% and other spent 100% of their income. Most of the household income was spent on tilling/Ploughing of land while least percentage was used in marketing. Some household did not use any percentage of their income on marketing, input purchase, storage, harvesting and planting.

The respondents were of the view that their household income was less adequate in relation to their farming requirements. There was significant relationship between household income and amount spent on farming as indicated by correlation coefficient of 0.588 implying that increase in household income would results to increase in the amount of money spent on farming.

It can be deduced that smallholder farmers in West Pokot County are unable to participate fully in farming activities due to inadequate financial resources. Inability to get adequate funds to purchase farming input has a bearing in agricultural productivity.

This is in agreement with World Bank (2008) which indicated that in Muranga and Meru, lack of cash kept smallholder farmers from using more fertilisers, seed and other inputs. Yahya and Xiaohui (2014) also asserted that inability to access to resources such as land and capital constrain smallholder farmers efforts towards ensuring food security at households. Abu and Soom (2016) also found that income of households head had a positive impact on household food security. Constraints such as lack of access to credits were identified as some of the factors militating against the achievement of food security in Nigeria.

Another aspect of socio-economic factor was education which was conceptualized in terms of knowledge and skills applied in farming. In this regard, the findings established that few of the sampled respondents have indeed participated in training on capacity building. The agricultural knowledge was found between low to moderate with majority of them indicating that they depend on their neighbors and relative to get information on agricultural production. Few trainings undertaken concentrated on nutrition and farming practices with few of them offering training and capacity building on climate adaptations. Level of education of the head of household is vital since they are the decision makers in matters concerning household expenditure. Education is expected to have positive influence on household food security.

As the level of education increases, the percentage of food secure households increases. This is expected because with increase in the level of education, individuals will be able to adopt more modern farm technologies on their farms thus improving their productivity. Level of formal education attained helps farmers to use production information efficiently, as a more educated person acquires more information and, to that extent, is a better producer (Abdulkadyrova et al., 2016; Mutisya, Ngware, Kabiru,

& Kandala, 2016). In addition, Enyedi & Volgyes, (2016) urges that education is important in agricultural transformation where it enhances the farmers' ability to receive, decode, and understand information. The level of farmers ‘education is believed to influence the use of improved technology in agriculture and, hence, farm productivity. The more the head of household is educated the more the household is likely to access enough food.

Educational attainment by the household head could lead to awareness of the possible advantages of modernizing agriculture by means of technological inputs; enable them to read instructions on fertilizer packs and diversification of household incomes which, in turn, would enhance households' food supply (Najafi, 2003). Amaza, Abdoulaye, Kwaghe and Tegbaru (2009) indicated that education helps the household head to use production information efficiently as a more educated person acquires more information and becomes a better producer. The level of education is believed to influence the use of improved technology in agriculture and, hence, improvement in farm productivity. The level of education determines the level of opportunities available to improve livelihood strategies, enhance food security, and reduce the level of poverty

The last aspect of socio-economic effect was land ownership and household decision related to farming practices. As in other African cultures and more so pastoralist communities, land in West Pokot is patriarchal owned. Therefore, the decision on land use is based on household head. The findings indicated that to a large extent, land ownership and the household decision making model affect household food security in West Pokot County as indicated by over 60% of sampled respondents. Most of respondents indicated that men as compared to female headed household preferred livestock farming although female headed household preferred crop farming.

From the findings, it can be postulated that household decision making on the use of available resources has an influence on household food security. Most of the African societies have assets and resources such as land and livestock which can be used to enhance food security at household level. Copeland and Guertin, (2013) claimed that the right to own, control and access land is fundamental to both food security and gender equality. Ownership, control and access to land can ensure that land is used to produce food for household consumption while the surplus can be sold to provide additional income that can be used to purchase food, or meet healthcare and other livelihood needs. The findings are also supported by a study done in Kakamega County; where husbands were willing to allow their wives to seek credit if neither land nor family property was pledged as security, which effectively eliminated formal credit for women. Moreover, women could not seek credit without their husband's permission, (WB, 2009).

The quantitative data collected was later subjected to regression analysis whereby it tested the first model of the study. The purpose was to test the first hypothesis which posited that **H_{01}**: There is no significant relationship between smallholder farmer's socio-economic factors and household food security in West Pokot County. Using simple regression analysis, the results indicated that socio-economic factors which comprised of household income, education level, land ownership and household decision has significant positive influence on the household food security in West Pokot Sub County as indicated by R square of 0.349. This implies that up to 32.9% of change in household food security in West Pokot Sub County is significantly influence by socio-economic factors. In regard to the first model of the study, the unstandardized B-coefficient yielded a value β=.699 which was significant at p=.000 implying that a unit change in socio-economic factors would result to significant change in household food security by 0.699 units. This finding agree with Rose, Gundersen and Oliveira (2008)

who found out that in the United States, households with higher incomes, homeowners, households headed by a high school graduate, and elderly households were less likely to be food insufficient. Holding other factors constant, those in low SES were over 3.5 times more likely to be food insufficient.

The findings were also supported by multiple linear regressions where socio-economic factors had a unique significant contribution to the model with the value for socio-economic factors (β=.288, p=.000). This implies that, when other variable in the model are controlled, a unit change in social economic factors would result to significant change in household food security in West Pokot County by 0.288 units in the same direction. These finding concurs with Musemwa, Zhou and Aghdasi (2013) who indicated that access to enough food was affected by gender of head of household, household size, education level of household head, agricultural training, poultry production and monthly total income of ordinary South Africans. Similar results were obtained in Tanzania by Mavole, Sitawa and Stella (2016) who found that socio-cultural and economic factors influence rural household food security in Bukoba District. The specific socio-cultural factors influencing rural household food security included household size and perception of the residents on culture. Access to credit was a problem to most of the farmers in Bukoba since there were few credit institutions. Ali, Mutundu and Ngare (2016) also found that socioeconomic factors were significant determinants of food insecurity in Somalia. The study concludes that the main socioeconomic factors that influence food insecurity among households are the gender of the household head, age, marital status, and households' weak income base.

In Turkey, Esturk and Oren (2014) found out that among the socio-economic variables, the income level was the most decisive variable for food security. The gender of

household head, employment status, education level and household count were the other variables affecting food security. Asghar and Muhammad (2013) indicated that socio-economic factors such as education of household head, annual income and agricultural income are some of the most important factors influencing the household's food insecurity status in Pakistan.

5.2.2 Smallholder farming characteristics on household food security

The second objective of the study was to evaluate smallholder farming characteristics on household food security in West Pokot County. The characteristics were informed by farm size, farming practices such as application of fertilizers and manure, use of improved seeds, type of food crops, number of cultivation per season and mixed farming practices. The findings revealed that 79.7% of the sampled households have their household land size less than 3.0 hectare although 7.9% had between 4 and 5 hectares. On the other hand, it was noted that 70.2% of the respondents cultivated less than 2 hectares with 32.4% cultivating less than 1.0 hectares. It can be deduced that most of the sampled households, did not utilized the available land for food production. A correlation was established between total arable land available and arable land under food production as indicated by R=0.570.

The results also indicated that most of the sampled household grew more than one food crop as indicated by 73.0% of the respondents. Maize was grown by all respondents and it was followed closely by bean at 58.0% of the respondents. Other crops were vegetable, potatoes, banana, carrot, cassava, millet and sorghum. The most dominant mixed cropping were maize and beans, maize and millet as well as maize potatoes and maize vegetables. The results also revealed that 3.3% of the farmers were able to grow a combination of five food crops.

The land under cultivation was established to less than 1000 hectares as it was 847.74. Maize was grown 613.9 hectares which is 72.4% of the total land. The land ranged from 0.25 hectares to 5 hectares with mean acreage of 2.60 hectares. Beans was grown 178.86 hectares which was 21.1% of the total arable land. Other food crops were cultivated in less than 15 hectares. The acreage ranged from 0.01 to 5.0 hectares with a mean of 1.21 hectares. The results also revealed that maize and cassava were grown for one season by all sampled respondents. However, carrots, peas and other legumes were grown thrice a season. Other crops such as beans, vegetable, millet, and banana were grown between one and three seasons while sorghum between one and two seasons.

The study also sought to establish farming practices from the perspective of improved seed, application of fertilizer and manure. The results indicated that 41.5% of the sampled respondents did not use improved seeds as compared to 5.4% who always used improved seeds. Those used improved seeds from moderate to more often were 29.8%. In regard to application of fertilizers, 26.6% did not used fertilizer at all as compared to 0.8% who always applied fertilizer. It was noted that 24.5% of the sampled respondents did not used manure as compared to 2.1% who used it always. Those used manure from moderate to more often were 31.1% of sampled farmers. It was noted that availability of improved seed, fertilizer and manure were some of the reason that sampled farmers did use them. Another significant reason was availability of cash to purchase them thereby denying them opportunity to utilize them in the farm. For manure, some of the respondents indicated that lack of skill, energy to carry to farms and some claimed the land was naturally fertile; therefore, there is no need to apply fertilizers and manure.

The study further sought to establish if respondents kept livestock besides crop farming. Majority of the respondents indicated they also kept livestock (72.2%). Majority of the

respondents kept between 1 and 20 livestock which included cattle, goats, sheep and poultry. The total number of livestock was 3,942 with a mean of 16 although it ranged from 2 up to 120. Total income from livestock was Ksh. 2,009,800 while the mean was Ksh. 12,000 per annum. It ranged from Ksh 400 to 100,000 in some households. The respondents affirmed that income from livestock has been decreasing over the years.

Inferential statistics was applied to test the second null hypothesis that **H_{02}**: There is no significant relationship between smallholder farmers' farming characteristics and household food security in West Pokot County. Using simple regression analysis, the results indicated that farming characteristics which included farming practices and size of arable land under food production has significant positive influence on the household food security in West Pokot Sub County as indicated by R square of 0.421. This implies that up to 42.1% of change in household food security in West Pokot Sub County is significantly influence by smallholder farming characteristics. The second model of the study, the unstandardized B-coefficient yielded a value B=.912 which was significant at p=.000 implying that a unit change in smallholder farming characteristics would result to significant change in household food security by 0.912 units. The findings were also supported by multiple linear regressions results which revealed unstandardized B coefficient of 0.401. This implies that when the variance explained by all other variables in the model is controlled. A unit change in smallholder farming characteristics would result to significant change in household food security in West Pokot County by 0.401 units in the same direction

5.2.3 Role of Farmers Household Labour Conditions on Household Food Security

The third objective of the study was to analyze the role of farmers' household labour conditions on household food security in West Pokot County. Household labour

condition in this study was conceptualized as the number of hours men and women member of household spent on their farms per day, task performed by men and household members of the family as well as utilization of the labour in the farm apart from household labour.

Majority of the household had between 2 and 7 household members of which between 2 and 4 were 29.9% while between 5 and 7 were 36.5% of the sampled household. From the total number of household, 45.2% of the respondents indicated that one of their male household members participated in the farm labour as compared 41.1% of female household members. The results further revealed that between 2 and 3 male members were 41.1% of the household members while for female it was 45.2% of female members. There was no significant different between 6 and 7 members and over 7 household members for both gender. This was further supported by independent t-test where there no significant difference between male and female hours spent on farm as indicated by mean difference of -.04979, C.I=-0.20560-0.10601, P=0.530.

Adekunle (2018) found that the larger the household size, the cheaper the farm labour. This is because household members are more likely to constitute a larger percentage of the labour used on the farm. The cost of labour also has been said by several literature to represent the largest share of the cost of production, and when cost of labour is reduced, the capital can be diverted into other cost of inputs such as fertilizer, seeds, pesticides, etc. These can help improve crop production on the farm. This is not different from the findings of Afolabi (2008) who found a positive relationship between family size and farm output and attributed it to respondent’s extensive utilization of family labour in the farming activities.

However, there was significant difference between male and female hours spent in the farm as shown by MD=0.94606, C.I=-0.75586-1.13625, P=0.000. This implies that more male household members (Mean=3.1701) as compared to female household members (Mean=2.2241) spent more time in their farm. This was supported by descriptive statistics which revealed that 67.6% of the male spent over 3 hours a day in the farm as compared to 32.3% of the female household members. Female spent fewer hours in the farm because of the other household chores which needed their attention. Another reason for zero hours was disability as some of the respondent had household member who were disable, thus they were unable to participate in farming activities. Age was another reason as elderly and young member spent few hours with some household member in these bracket spending zero hours.

More male were involved in Ploughing/tilling of farms as compared to female as indicated 87.6% against 33.2%. Male were also involved in weeding, harvesting, top dressing and livestock keeping more as compared to female. However, women were more visible in post harvesting especially winnowing, sorting and dry as compared for male. Women were also more in planting/sowing as compared to male counterpart.

Household labour was used always in West Pokot County as indicated by 58.9% as compared to non-household labour of which 56.0% of the respondents indicated they did not use because it was expensive. However, some of the household used tractors for land cultivation while some hired non-household members to supplement the existing labour especially during planting and weeding. Adekunle (2018) asserted that small holder farming mostly utilizes family labour often augmented with minor hiring of labour and labour exchanges with other farmers at peak seasons.

Inferential statistics was utilized to test the third null hypothesis that **H_{03}**: There is no significant relationship between smallholder farmers' household labour condition and household food security in West Pokot County. The results indicated that labour condition has significant positive influence on the household food security in West Pokot Sub County as indicated by R square of 0.372. This implies that up to 37.2% of change in household food security in West Pokot Sub County is significantly influence by household labour conditions. From the third model of the study, the unstandardized B-coefficient yielded a value B=.670 which was significant at p=.000 implying that a unit change in labour conditions would result to significant change in household food security by 0.670 units. The findings were also supported by multiple linear regressions results which revealed unstandardized B coefficient of 0.264. This implies that when the variance explained by all other variables in the model is controlled, a unit change in labour conditions would result to significant change in household food security in West Pokot County by 0.264 units in the same direction.

5.2.4 Influence of climate variability on smallholder farmers activities towards achieving household food security

The fourth objective of the study was to determine the influence of climate variability on smallholder farmer's activities towards achieving household food security in West Pokot County. Climate variability was determined based on the significant change in whether over last 20 years, the impact of these changes to local community, adjustment done in relation to climate variability and organizations involved to address effect of climate variability.

Majority of the respondents indicated that there is significant change in rainfall pattern as shown by 63.1% of the respondents over the last 20 years. This was associated with

prolong drought and to some extent very hot seasons. Only 2.5% indicated that there have been incidences of very wet seasons. The number of hot day have been increasing over the last 20 years as indicated by 73.0% of the respondents whole only 1.7% of the respondents indicating they have been declining. The number of rainfall over the last twenty years has declined as indicated by 58.5%. Another significant change related with rainfall is that there has been changes in timing as shown by 41.9% and change in the frequency of drought and flood as indicated by 35.5% of the sampled household respondents.

The effect of climate variability has led to crop failure as indicated by 85.1% of the sampled respondents. Crop production has been immensely affected due to drying of crops due to lack of adequate moisture. The most affected crops were the one that long time to mature or they need rainfall during flowering. The climate change has results to low crop productions due to attacks from pest and diseases due to high temperatures or delay in planting. In the past season, farmers in West Pokot County have report army worms and locust as some of the reason of reduced productivity.

On the other hand, there has been dead of livestock due to lack of pasture, outbreak of livestock diseases due to high temperature and lack of water for livestock as indicated by 40.7% of the respondents. These two factors, water and pasture has resulted to human conflicts which indirectly has affected household food security. Migration to other places due to conflicts has resulted to reduction in the number of hours spent on farm for crop production which affects food availability. Food accessibility has also been affected by climate variability has human conflicts have reduced avenue for household to access food through relief or purchase due to insecurity.

Human disease outbreaks as a result of climate change have also affected household food security as indicated by 38.2% of the sampled household respondents. The researcher noted that, change in temperature has resulted to increase of tropical diseases such as malaria while flood has led to outbreak of water borne diseases such as typhoid. This does not only affect labour in farming activities but also result to spending of family income to access health services which further affect food availability and accessibility in West Pokot County.

Majority of the respondents were found to be involved in various adjustments to address effect of climate variability in West Pokot County. The most common adjustments were change in crop variety (42.3%) and change in planting dates (40.7%). Other notable adjustments were diversification of crop types and varieties; reduce number of livestock and changing size of land under cultivation. However, little was done in relation to diversify from farming to non-farming activity, implement soil conservation schemes, diversification of livestock types and varieties, irrigation and build water harvesting schemes.

The major constrains for adaptation measures were lack of capital as shown by 75.1% of the respondents and lack of information as indicated by 68.5%. The researcher noted that most of the adjustments such as irrigation and building water harvesting schemes require adequate capital. The level of poverty in some household does not allow them to invest in such adjustment related to climate variability. Lack of information was associated with changing of crop variety, changing of planting dates, diversification of crop types and varieties and reduction number of livestock. The researcher noted that some of the respondents were not aware which crop varieties to plant and when to plant

them. In this case, the impact of climate variability negatively affects their household food security situation.

Slight majority of the respondents affirmed that some institutions and organization have been involved in order to address effects of climate variability to the local communities found in West Pokot County as indicated by 55.6% of the respondents. The notable organizations were NGOs, government ministry and private sector especial media.

Inferential statistics was utilized to test the fourth null hypothesis that **H_{04}**: There is no significant relationship between climate variability and household food security in West Pokot County. The results indicated that climate variability has significant negative influence on the household food security in West Pokot Sub County as indicated by R square of 0.375. This implies that up to 37.5% of change in household food security in West Pokot Sub County is significantly influence by climate variability. From the fourth model of the study, the unstandardized B-coefficient yielded a value B=-0.641 which was significant at p=.000 implying that a unit change in climate variability would result to significant change in household food security by 0.641 units in the opposite direction. The findings were also in consistent with multiple linear regressions results which revealed unstandardized B coefficient of -0.289. This implies that when the variance explained by all other variables in the model is controlled, a unit change in climate variability would result to significant change in household food security in West Pokot County by 0.289 units in the opposite direction.

5.2.5 Farmer association as a moderating variable on smallholder farming and household food security

The fifth objective of the study was to establish how farmer association as a moderating variable influences the relationship between smallholder farming and household food

security in West Pokot County. This was a composite objective which was further divided into four sub objectives which include to examine how farmer association moderates socio-economic factors on smallholder farmers' contribution to household food security in West Pokot County, evaluate how farmer association moderates smallholder farming characteristics in West Pokot County, to analyze how farmer association moderates smallholder farmers household labour conditions in West Pokot County and to determine how farmer association moderates the influence of climate variability on smallholder farmers activities towards achieving household food security in West Pokot County.

The results indicated that less than half of the sampled respondents had membership in various group/association that aid in farming activities as indicated by 47.3%. This finding is similar to Mwaura (2014) who found out that membership to farmer groups in Uganda is low. Only 16 percent of household heads belonged to a group. The low uptake of group/association membership was as a result of lack of groups/association in some parts of West Pokot County (63.8%), lack of information (40.9%), lack of time and perceived benefit in that order. Adekunle (2018) asserted that lower farming experience have higher probability of being a member of a group farm. This can be attributed to the fact that farmers who have lower farming experience are likely to limited knowledge in the production of some crops, and also not likely to have access to sufficient farm inputs, they therefore join group farming to help in access to inputs and trainings by the government or interaction and activities on the farm by the group members. This finding also agrees with literature that most of the participants of group farming cooperatives are the farmers who are new to the profession (Inan, 1984). This can be attributed to the fact that farmers who have high farming experience are usually older and are more resistant to change than new entrants.

Majority of the respondents were found to be in one group although some of them had membership in more than one group (31.4%). Adekunle (2018) revealed that other forms of group membership have a positive relationship with membership of group farm. This implies that, farmers who are members of other forms of groups, have a higher likelihood of joining a group farm. This is probably because cooperative is a form of social network where ideas and innovations are being discussed. It is also a platform for connections among farmers, therefore there is a high tendency that a member of other forms of group are likely to participate in group farming compared to non-member of any cooperative society. These results also corroborate that of Prakash (2000) that cooperatives have even greater potential for coordinating self-help actions and platform group farmer's formation.

Most of the members have participated in these groups between 7 and 12 months (47.4%) with 14.9% having participated in their groups for more than one year. The shorter the duration of group meeting intervals increases cohesiveness in the group improving the chances of more information sharing and distribution of introduced crop varieties since they are in touch with the happenings. Most farmers based organizations have monthly meetings which serve to gather members together to collect contributions or dues and also to share benefits such as seeds and other technologies (Salifu *et al.,* 2012).

In regard to specific sub objectives, the results indicated that 23.5% of the 114 members who participated in various groups received financial support although 36.0% of them affirmed that their group offered financial support. The total amount awarded in the last season was Ksh. 283,000 and the amount ranged from Ksh 400 to 30,000. Majority of them indicated that the financial support was inadequate for it to have meaningful contribution to farming. The farmers' associations in Taiwan are generally recognized

as very effective in financing agricultural production. Because they have an intimate knowledge of the farmers' needs and are capable of linking the farmers' borrowings with extension services, they are in a position to render credit service directly to the farmers. It has contributed greatly to the successful implementation of agricultural development programmes (Wang, 2009)

In regard to capacity building and training support from the groups, 57.9% of the 114 members in the group affirmed their groups organize capacity building and training. However, only 47.9% have attended such forums. Those attended the capacity building were mainly trained on pest and disease control as indicated by 51.7%. Other training included nutrition, use of manure, planting, fertilizer and livestock production. Carney (1996) indicated that working with groups seemed to offer a partial solution to food insecurity. Many donor-funded projects looked to improve their effectiveness and efficiency through sponsoring the formation of groups to meet their immediate project objectives. At the same time, Training and Visit extension systems began to move from working with individual often isolated contact farmers to working with groups.

In addition, Benin *et al.,* (2011) reported that groups supported by NAADs promoted improved seed and high yielding enterprises, but failed on soil fertility enhancing technologies. Although farmers in groups were observed to have adopted improved crop technologies more than the non-members in Kenya, Uganda and Tanzania, non-group members showed significantly higher levels of livestock vaccination (Friis-Hansen & Duveskog, 2012). Davis *et al.,* (2012) showed that group members had no significantly higher crops yields than nonmembers in Uganda, while in both Kenya and Tanzania; group members had recorded significant higher yields and household incomes.

However, Blekking (2017) found that in Zambia groups/associations seldom operate with the goal of diffusing knowledge and educating members. In conclusion, socioeconomic characteristics such as age, education, wealth and gender matter in distribution of benefits of group farming cooperatives. In Uganda, Mwaura (2014) indicated that group members were less likely to adopt inorganic fertilisers and improved seed ($P<0.05$) than non-groups members.

In regard to farming practices, majority of the respondents 36.8% indicated that group/association offer advice and demonstration on mixed crop and it effectiveness was moderate and it was followed closely by mixed farming (31.6%) which was moderately effective and similar percentage was evident for pest and disease control. Application of fertilizers is evident as indicated by 23.7% and it was moderately effective while use of manure was also found to be moderately effective as indicated by 21.9%. The frequency of support and advice on neglected/orphan crop and post-harvest management was low while the frequency on food preservation was high. Majority of the support and advice on farming practices was moderately effective except for food preservation and post-harvest management.

Further, Njagi (2016) revealed that that the more the trained a group was the more likely it was to distribute seeds to more group members. Likely explanation for this is that through trainings, farmers are able to acquire knowledge and awareness on production of various crop varieties thus increasing the likelihood of adoption once a crop is introduced to the group. In groups‟ trainings farmers also have a platform to share ideas and experiences thus forging a positive way forward. This implies that farmers‟ participation in trainings can enhance their awareness on the importance of new crop varieties distribution and adoption. According to Macharia *et al.*, (2014) the more

trained the households were the more knowledgeable they were likely to be since training is an important component of instilling skills and hence builds capacity of the target group. Further, Kristin *et al.,* (2010) noted that number of trainings positively influences technology distribution. The results agree with Pierre-André *et al.,* (2010) who observed that through training the farmers acquire knowledge that leads to increased agricultural technologies distribution and production.

In regard to farm labour conditions, only 29.8% of the respondents did affirm that groups organized for labor either directly or indirectly. Majority of the respondents indicated that the number of farm labour organized by groups/association was once per season. The respondents indicated that farm labour from groups/association was mainly utilized during tilling (24.6%) and it moderately effective. It was also used during harvesting as indicated by 24.0% of the respondents and it was also effective. However, it was less utilized during sorting and packing and application of fertilizers besides been moderately effective for the latter and less effective for the former. Adekunle (2018) found the mean labour productivity of group farm are 1943.98kg/man-day while that of individual farmers is 281.66kg/man-day. This also shows that the labour productivity of the group farms is higher than that of individual farms with about 1662.32kg/man-day.

In regard to climate variability, less than half of the respondents indicated that they received advice and information on climate variability as shown by 43.0%. The information was mainly on rainfall pattern, duration and amount followed by changes in temperature. Change in crop variety was at moderate frequency and it was highly effective as indicated by 38.6%. Diversification of crop types and varieties was also at moderate frequency and it was highly effective as indicated by 36.3%. Changing of

planting date was also at moderate frequency and it was highly effective as indicated by 25.4%. On the other hand, build water harvesting schemes was at low frequency and it was lowly in terms of effectiveness in West Pokot County. This was also evident for Implement soil conservation schemes, diversification of livestock types and varieties and changing size of land under cultivation. The results further revealed that even though diversify from farming to non-farming activity was less frequently advised by farmer groups, it was moderately effective. On the other hand, even though the frequency of information on irrigation was moderate, it was found to be less effective in West Pokot County.

Moderated multiple linear regression was used to find moderating effect of groups/association on household food security. The results revealed farmer association had insignificant improvement to the model and it does significantly not moderate the relationship between the socio-economic factors and household food security (P=0.714). In the overall study model, farmer associations have insignificant moderating effect on the relationship between socio-economic factors and household food security as shown by P=0.317.

However, results revealed farmer association had significant improvement to the model due to introduction of the interaction terms an indication that farmer association moderates the relationship between the smallholder farming characteristics and household food security (P=0.000). In the overall study model, farmer associations have significant moderating effect on the relationship between smallholder farming characteristics and household food security (P=0.000). This means that, as participation of farmers association increases by one unit, the level of smallholder farming characteristic effect on household food security significantly increases by 0.569 units. Adekunle (2018) found that farmers who participate in farmers' group have their

individual farms to help increase production, with the effort of joint participation, increased farm size, sharing of skills and experience, reduction in cost labour, and production of more than one crop, and mechanization. Msuta and Urassa (2015) indicated that an increase in access to extension services by farmers' organization members enables farmers to improve farming which leads to increased crop yields as well as income and assets ownership. Generally, access to extension services by farmers' organization members created awareness particularly of modern farming techniques, which helped them to improve agricultural productivity and increase income and assets ownership. This observation also conforms to what was reported by Mushi (2000) that access to extension services assists farmers to solve farming problems. Moreover, pest management techniques (both conventional and the integrated pest management practice (IPM) learned or obtained through FO's could lead to a reduction of incidences of diseases and pests and thereby improve the quality and quantity of agricultural produce

The results revealed farmer association had significant improvement to the model due to introduction of the interaction terms an indication that farmer association moderates the relationship between the household labor conditions and household food security (P=0.000). However, Farmer associations have insignificant moderating effect on the relationship between household labor condition and household food security (P=0.318).

The results also revealed farmer association had significant improvement to the model due to introduction of the interaction terms is an indication that farmer association moderates the relationship between the climate variability and household food security (P=0.000). In the overall study model, farmer associations have significant moderating effect on the relationship between climate variation and household food security

(P=0.000). This means that, as participation of farmers association increases by one unit, the level of climate variable effect on household food security significantly increases by 0.549 units.

5.3 Conclusions of the Study

From the first objective findings, the study concluded that socio-economic factors influences household food security in West Pokot Sub County. In particular, it was established that improvement in socio-economic factors would results to increase in household food security in the county. The study indicated that most of the sampled households earned less than Kshs. 20,000 per years which was inadequate to support farming. In that case, the percentage of their income spent on farming in most households is less than 50% with some of them spending less than 5% of their income. This implies that farming in the county has not yet received the required financial support. Some of the aspect of farming that has been received inadequate financial support includes marketing and purchase of input. This implies that, smallholder farmers in West Pokot are in vicious cycle of low productivity because they are unable to use required inputs to realize improved produce. On the other hand, poor marketing means that excess/surplus is not able to fetch required income from the market. This affects food accessibility especially during drought season where farmers are required to use their saving to address household food insecurity. This also results to less productivity as they are unable to invest in their farming practices.

The study also concluded that farmers in West Pokot Sub County have inadequate knowledge and skills to enable them use the available resources to achieved improved farm productivity. Few of them have participated in various training and capacity building in the county in relation for farming. As a result, there they farming practices

are outdated resulting to low yield. It was also noted there is presence of few institutions and organizations which offer agricultural information in the county, as a result, farmers are unable to acquire to required knowledge and skills to adopt new and improved methods of productions.

The study also concluded that, land ownership and household intra-decision have a bearing on food security. The patriarchal culture of the community implies that, a dominant gender (male) makes also decision pertaining land use and this limit the adoption of mixed farming which is a form of diversification aimed to improve household food security. Most of the male headed household made decisions on land use that favor livestock keeping as compared to crop production. However, livestock keeping has been associated with conflicts and land degradation, as well as death due to famine. This has heightened the status of the existing food insecurity in the county.

The study concluded that smallholder farming characteristics influences household food security in West Pokot County. Size of land under food production is associated with quantity of food production especially food crops whereby, household with significant arable land size are able to produce adequate food for household consumption as well as surplus to supplement other household needs. However, other factors were also found to be associated with food security under farming characteristics. The smallholders' farmers in West Pokot County overly rely on maize production which is staple food in most household in Kenya. The maize is grown once per season which may have negative effect on the household food security and therefore, most of the farmers have practiced mixed farming with beans been the most common crop grown with maize. More than half of the land in the county is used for maize production and is followed closely by beans. Other notable crops were sorghum,

millet, carrot, and cassava and vegetable although they occupied less percentage of total acreage. It is also worthy to note that some households, in effort to increase food availability have grown more than four food crop per season in there, however, this was limited by small sizes of land.

Use of improved seeds has not gain credence in West Pokot Sub County as most of the household did not use hybrid seeds. The same was also reflected for fertilizers although some of the household applied manure as they are involved in mixed farming. The main inhibiting factor is the accessibility of improved seeds and fertilizer as a result of physical accessibility and lack of money to purchase farm inputs. The households view the farm input to be expensive and therefore, they prioritize other basic needs thereby decrease availability of household food. This also affects accessibility, stability and utilization of food in some household. The application of manure was hampered by availability of labour as some households were unable to transport manure to farm.

Through the practice of mixed farming, the household in West Pokot County also kept livestock such as cattle, goats, sheep and poultry with cattle accounting more than 50% of the livestock. However, the livestock were indigenous meaning that they fetch less income especially from milk sales and other dairy produce. In this case, income earned from livestock was not adequate to fully cushion farmers from unpredictability of crop farming which is affected by climate change. Household which are involved in mixed farming have high chances of achieving food security as they are able to diversify their livelihood options.

In regard to household labour condition used by smallholder farmers, the study concluded that it has a positive and significant effect on household food security. The labour used by smallholder farmers in West Pokot is mostly family members. This is

facilitated by large number of household and inability to hire paid labour. Overall, male members were more involved in the provision of household labour as compared to female. Male were found to spend more hours in the farms as compared to male. Male also participated in majority of farming practices such as tilling, weeding, top dressing, harvesting and livestock keeping. On the other hand, women participated more in planting and post-harvest management. However, it was noted that, cultivation of land and rearing of livestock depended on the labor available in the household. This implies that household with more family members are able to cultivate large acreage for food production and participate in keeping of livestock.

It was found that women spent less in the farms due to household chores and this situation is worse for female headed households in West Pokot County. Another group that was negatively affect by household labor was disables members and elderly. These two groups are unable to participate in farming activities because they lack energy and means to reach to their farms. The situation is worsened by lack of resources especially financial to hire labourers to assist in farming activities. Less involvement in farm labour in this household negatively affects all aspect of household food security from availability, accessibility, stability and utilization.

Climate variability has significant negative influence on the household food security in West Pokot Sub County. This implies that increase in climate variability would results to decrease in food security in some households. It is worthy to note that in the last 20 years, household in West Pokot Sub County have witnessed change in rainfall, unpredictability of rainfall and changes in Temperature. The numbers of hot days have increases while the rainfall amount has been decreasing with increase in unpredictability. Specifically changes in rainfall amount and pattern has hurt farmers

especially in crop production as it has results to decrease in crop productivity due to crop failure and attack by pest and diseases.

On the other hand, change in temperature has results to increase in pest and diseases for livestock, crops and human which has significantly affected stability, accessibility and availability of food. Drying of water sources and reduction of livestock pasture due to prolong drought has also resulted to conflict especially between livestock keepers as well as between livestock keepers and crop farmers. This has results to displaced, loss of asset hence increase in food insecurity as household are unable to participate in activities that would results to increase in food security.

Households in West Pokot County have made various adjustments to minimize the impact of climate variability such as change in crop variety and changes in planting date. Various organizations and institutions especially NGOs, Government Ministries and private sector especially media have been involved in climate change adaptation measures. However, these and other adjustment such as diversification of crop types and varieties, diversify from farming to non-farming activity, implementation soil conservation schemes, diversification of livestock types and varieties, irrigation and building of water harvesting schemes have been hampered by lack of resources especially financial and lack of information. This implies, the adaption measures have not been fully undertaken in West Pokot County.

The study concluded that farmer associations/groups had significant moderating influence on the effect of farming characteristic practices and climate variability on household food security. It was evident that the level of participation in farmers' groups/association is low in West Pokot County. The low rate of participation in groups should also concern policy makers, especially considering that the county is not food

sufficient. It worthy to note that, increase in participation of farming association increase the influence of farming practices on household food security while increase in participation of farming association increase the influence of farming practices on household food security. These two variables were significant unlike socio-economic factors and household labour conditions in West Pokot County. Participation of farmers' groups/associations leads to empowerment of farmers; it assists farmers to gain access to market and sell their produce with better profit. It can also be deduced that, farmers take advantage of bulk purchase of farm inputs that helps them to reduce the cost of production and obtain standard quality products; group farming allows the farmers to attract government and donor agencies attention (Adekunle, 2018).

5.4 Implications of the Study

Collective action through farmer groups can be an important strategy for members to strengthen their political power, gain skills, access inputs, form enterprises, process, and remain competitive in rapidly changing markets (Penunia, 2011). Literature also suggests that when farmers are organized in groups, the efficiency of service delivery to the community improve (Adong, Mwaura, & Okoboi, 2013). As a result, group-based approaches have increasingly been used by government and non-governmental initiatives to improve farmers economic and social being.

Collective action plays an important role in both political and economic agricultural transformation. Politically, collective action helps to strengthen the political power of members by increasing the likelihood that their needs and opinions are heard by policy-makers and the public. Economically, it helps farmers gain skills, access inputs, form enterprises, process and market their products more effectively to generate higher incomes. It is also associated with easy access to information. It also helps to lower

production costs which facilitate further processing and marketing of agricultural commodities. In addition, well organized farmers have greater bargaining power than individuals which puts them in better positions to negotiate with other more. The success of collective action depends on member commitment to fulfill mutual stated obligations (Fischer & Qaim, 2011).

Penunia (2011) highlights the various ways in which FGs can form essential institutions for enhancing agricultural transformation of the rural poor. Politically, they strengthen the political power of members (women) by increasing the likelihood that their needs and opinions are heard by policy-makers and the public. Economically, FGs can help farmers gain skills, access inputs, form enterprises, process and market their products more effectively to generate higher incomes. When farmers are well organized, they can easily access information needed to produce, add value, market their commodities and develop effective linkages with input agencies such as financial service providers, as well as output markets. Also once FGs have achieved economies of scale, they can lower production costs which facilitate further processing and marketing of agricultural commodities for individual group members. In addition, well organized farmers have greater bargaining power than individuals which puts them in better positions to negotiate with other more powerful market players to ultimately increase the profits that accrue to farmers rather than intermediaries and buyers (SARD, 2007)

5.5 Recommendations

Basing on the conclusion, the study recommends that the National Government, County Governments, NGOs and development partners concerned with food security should come up with approaches that would ensure smallholder farmers are able to access credit and financial support so as to invest in farming. This can be achieved through

microfinance support specially targeting smallholder farmers. On the other hand, there is need to improve market accessibility to smallholder farmers so that they are not exploited by middlemen, the returns can be plough back through purchase of farm inputs. The study also recommends that, there is need to increase extension services in the county as these services would increase farmers' knowledge and skills in agricultural production.

The size of arable land under cultivation cannot be easily increased unless through acquisition of new piece of land and proper use of available land. This can be done through mixed crop where farmers can cultivate various crop including short maturity with drought resistant crops and the same time livestock farming so that dropping from animals can be used as manure and remain of crops can be utilized as livestock fodder and feed. The study also recommends that the National government should subsidized farm inputs especially seeds, fertilizers and livestock inputs so that they are accessible to farmers. On the other hand, County Government should initiate projects that would improve agricultural productivity especially livestock production and offering of farm inputs to less fortunate households.

In regard to labour conditions, the study recommended that there is need to free female members of household so that they can participate in farming activities in West Pokot County. This can be achieved by doing away with retrogressive culture that women cannot participate in certain farming activities in absence of male figure. The study also recommends that there is need for county government to encourage farming through offering of tractors to plough land for those household which has large tract of land that are not utilized for food production.

In regard to climate variability and household food security, the study recommended that the farmers, governments, NGO and other development partners have a role to play so as to ensure the effects of climate variability does not affect food security negatively. The National and County Government should set budget for climate mitigation and the same can be replicated by development partners and the United Nation. These organizations/institutions should also increase awareness and sensitization of local community on the climate variability and available adaptation measures. Early warning systems should be put in place and this would heighten adaptation measures in West Pokot County.

In regard to farmer association/groups, the study recommended that there is need to increase number of groups/association related to farming and at the same time to increase their capacity to offer support to smallholder farmers especially financial support, training and organized labour. In regard to poverty level in West Pokot County, smallholder farmers can access farm inputs through bulky purchase, access training services and other technologies to be used in agricultural production. Besides, farmer association/groups can through collective responsibility adopt mechanized labour which would increase food production. Therefore, both national and county government as well as NGO and development partners should fast track formation of such groups and associations that are farmer based. Both the governments and non-governmental organization should develop strategies that will encourage participation in farmers' groups and also create more awareness among farming households, which can motivate more farmers to partake in group activities.

5.5.1 Recommendations for Further Research

The study sought to establish the contribution of smallholder farmers on household food security in West Pokot County, Kenya with specific interest of farmers' associations/groups. The results established that farmer's participation in groups/association influenced household food security. However, majority of the group membership was female and therefore, future studies should be conducted on female headed households which are part of groups/association to establish how it influences household food security.

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APPENDICES

Appendix I: Household Questionnaire

I am a post graduate student pursuing a Doctor of Philosophy Degree in Development Studies at Moi University. As part of the university's requirement, students must carry out a research in order to merit an award of a Doctorate Degree. This questionnaire is designed to find out the contribution of smallholder farmers to household food security in agro-pastoral zones in West Pokot County, Kenya.
Your response to the items in the questionnaire will be absolutely confidential. Please carefully read the instructions before you complete the questions
Thank you for your co-operation.

INSTRUCTIONS

- *Do not indicate your name on this questionnaire*
- *please respond by ticking (√) in the appropriate box and filling in the spaces provided*
- *All items should have only one response*
- *please respond to all items in the questionnaire*

SECTION A: BIO DATA OF THE RESPONDENTS

Kindly tick (√) in the box next to the right option

A1: What is your gender?

Female [ ]
Male [ ]

A2: Age

<20 [ ]
20–29 [ ]
30-39 [ ]
40-49 [ ]
50-59 [ ]
>60 [ ]

A3: Your highest level of education

No education [ ] Primary [ ] Secondary [ ]
Tertiary [ ] University [ ]

A4: What is your marital status?

Single [ ]
Married [ ]
Married and polygamous [ ]
Widow/widower [ ]

A5: Are you the head of the household?

Yes [ ]
No [ ]

SECTION B: SOCIO-ECONOMIC FACTORS

B1: What is your average annual income?

Less than Kshs.10, 000 [ ] Kshs. 10,001-20,000 [ ] Kshs.20, 001-30,000 [ ] Kshs. 30,001-40,000 [ ] Kshs. Over 40,000 [ ]

B2: What amount of money do you spend in farming per year?

Less than 5,000 [ ] 5,001-10,000 [ ] 10,001-15,000 [ ]
15,001-20,000 [ ] Over 20,000 [ ]

B3: What is the percentage of your income do you spend in farming? _____

B4: State the percentage of income that is used in the following farming practices

Tilling [ ] Planting [ ] Weeding [ ] Harvesting [ ]
Storage [ ] Purchase of input [ ] Marketing [ ]

B5: In a scale of 1 to 5 rate the adequacy of your income in relation your farming requirements: 1 [ ] 2[ ] 3[ ] 4[ ] 5[ ]

SECTION C: FARMING CHARACTERISTICS

C1: What is the total size of household arable farm?

0-1 [ ] Between 1.1-2 [ ] 2.1-3-[ ] 3.1-4[ ] 4.1-5[ ]

C2: What is the total size of household arable farm that is cultivated for food crop production?

0-1 [ ] Between 1.1-2 [ ] 2.1-3-[ ] 3.1-4[ ] 4.1-5[ ]

C3: What are some of the factors that influence the size of household farm under food crop cultivation?

_____
_____
_____

C4 State the type of food crop, acreage under cultivation and number of times per season

Type of Food Crop	**Land size (Hectares)**	**Number of times per season**

C5: How often do you use hybrid seed to enhance production?

Not at all [ ] Less often [ ] moderate [ ] more often [ ] always [ ]

In case of less often and not at all, what is the constraints_____

_____

_____

In case not at all, how many Kgs do you use_____

C6: How often do you use manure in your farm to enhance production?
Not at all [ ] Less often [ ] moderate [ ] more often [ ] always [ ]
In case of less often and not at all, what are the constraints_____
C7: Do you keep livestock?
a) If yes, please list them down and the number owned.
b) Does livestock keeping increase your income? By how much annually?

SECTION D: LABOR DIVISION

D1: What is the total number of members in your household?

1 [ ] Between 2-4 [ ] 5-7 [ ] 8-10[ ] over 10 [ ]

D2: How many of your household members provide labour in the farms?

Male	1 [ ]	Between 2-3 [ ]	4-5 [ ]	6-7[ ]	over 7 [ ]
Female	1 [ ]	Between 2-3 [ ]	4-5 [ ]	6-7[ ]	over 7 [ ]

Indicate the type of gender that performing the following farming tasks

Task	**Male**	**Female**
Ploughing/Tilling		
Planting/sowing		
Weeding		
Top dressing		
Harvesting		
Post harvesting e.g. winnowing, sorting, drying etc.		
Livestock keeping		

D3: State the approximate number of hours spent on farm

Male	0 hrs. [ ]	Between1-2 [ ]	3-4 [ ]	5-6[ ]	over 6 [ ]
Female	0 hrs. [ ]	Between 1-2 [ ]	3-4 [ ]	5-6[ ]	over 6 [ ]

For zero hours, state the reasons_____

_____

_____

D4: How frequently do you use family labor in the farm?
Not at all [ ] Less often [ ] moderate [ ] more often [ ] always [ ]
In case of less often and not at all, what are the constraints_____

_____

_____

D5: How frequently do you use paid labor in the farm?
Not at all [ ] Less often [ ] moderate [ ] more often [ ] always [ ]

SECTION E: CLIMATE VARIABILITY

E1: What significant changes in weather have you observed in your community over the last 20 years?

Unpredictable rains[ ] Prolonged drought [ ] Very hot seasons [ ] Very wet seasons[ ]

E2: What is the main impact of these changes on the local community?

Crop failure [ ] Flooding [ ] Human disease outbreaks [ ]

Livestock disease outbreak [ ] Famine [ ] Migration to other places [ ]

E4: i) What changes would you associate with climate change on each of the following?

Crop production_____

_____

Livestock production_____

_____

Income generation_____

_____

Human health_____

_____

Water sources_____

_____

ii) What has happened to the number of hot days over the last 20 years?

Nothing [ ] Iincreased [ ] Declined [ ] More extreme [ ] Less extreme [ ]

iii) What has happened to the number of rainfall days over the last 20 years?

Increased [ ] Declined [ ] Change in the timing of rains [ ] Decrease in rains and change in timing [ ] Change in frequency of droughts/floods [ ]

iv) Have you made any adjustment in your farming practices to climate variability and change? Yes [ ] No[ ]

E5: What adjustments have you made in your farming practices to these long-term shifts in temperature and rainfall? Tick the adjustments made. (Multiple responses allowed)

Change crop variety [ ]

Build water harvesting schemes [ ]

Implement soil conservation schemes [ ]

Diversification of crop types and varieties [ ]

Diversification of livestock types and varieties [ ]

Changing planting dates [ ]

Changing size of land under cultivation [ ]

Irrigation [ ]

Reduce number of livestock [ ]

Diversify from farming to non-farming activity [ ]

Indicate the main constraints to adaptation measures

Lack of capital[ ] Lack of information [ ] Shortage of labor [ ]

Lack of access to water[ ] Poor health [ ]

Others_____

i) Are there institutions/organizations your community has worked with to address the effects of climate change on livelihood?

   Yes [ ] No [ ]

ii) If, yes please indicate what type of institutions/organizations they were?

   NGOs [ ] Government ministry [ ] Private sector [ ]

   An individual [ ] Others (specify)_____

SECTION F: FARMERS GROUPS/ASSOCIATIONS

F1: Are you a member of farmers' groups/association/organization?

Yes [ ] No [ ]
If no, state the reasons_____
_____
_____

If yes, how many formations? _____

If yes, for how long have you been a member of these formations?

F2: Have you attended farming capacity building/training in the last 12 months?

Yes [ ] No [ ]

F3: What kind of training were you offered? _____

_____
_____

F4: Has any member of your household attended farming capacity building/training in the last 12 months? Yes [ ] No [ ]

F5: In a scale of 1 to 5 rate the effectiveness of capacity building/training in relation farming productivity 1 [ ] 2[ ] 3[ ] 4[ ] 5[ ]

What are source of your income used in farming
_____
_____
_____
_____

a) Socio-economic

i) Does your group organize for financial support or credit for its members?

Yes [ ] No [ ]

ii) If yes, have you received any financial support/credit from your group?

Yes [ ] No [ ]

iii) If yes, How much in total in year? _____

iv) How adequate is the financial support from your group?

Not at all [ ] less adequate[ ] moderate [ ] just adequate [ ]
very adequate [ ]

v) Does your group organize farmers capacity building/training?

Yes [ ] No [ ]

vi) If yes, how many times have you attended?_____

vii) If yes, what were you trained on

Tilling [ ] Planting[ ] weeding [ ] fertilizer application [ ] use of manure [ ]

Harvesting [ ] post-harvest management[ ] Nutrition [ ] pest & disease control [ ] Others_____

viii) How effective is the group training/capacity building in relation to farm productivity?

Not at all [ ] less adequate[ ] moderate [ ] just adequate [ ] very adequate [ ]

b) Farming Practices

i) Does your group offers advices and demonstrate on the following farming practices

	Yes/No	**Frequency Range 1 to 5**	**Effectiveness Range 1 to 5**	**What it entails**
Mixed crop				
Mixed farming				
Mono-Cropping				
Application of fertilization				
Use of manure				
Selection of hybrid seeds				
Food Preservation				
Pest and disease control				
Post-harvest management				
Drought resistant crops				
Neglected/orphan crop such as millet etc				
Other (specify)				

c) Household farm Labour

i) Does your group organizes for farm labour to its members Yes [ ] No [ ]

If yes, how many times in a season?

Once [ ] Twice[ ] Thrice [ ] Four times [ ] more than 4 times [ ]

ii) Which farming activities do you receive labour from your group members?

	Yes/No	**Effectiveness Range 1 to 5**	**What it entails**
Tilling			
Planting			
Weeding			
Application of fertilization			
Use of manure			
Harvesting			
Sorting and Packaging			
Marketing			
Other (specify)			

d) Climate Change

i) Does your group provide any information on climate variability?

Yes [ ] No [ ]

ii) If yes, what kind of information have you received?

Change in Rainfall pattern [ ] Increase in temperature [ ]

Increase in Humidity [ ] others (specified)

iii) Indicate if you have employed any of the following climate change adaption strategies and its effectiveness

	Yes/No	**Frequency 1 to 5**	**Effectiveness 1 to 5**
Change crop variety			
Build water harvesting schemes			
Implement soil conservation schemes			
Diversification of crop types and varieties			
Diversification of livestock types and varieties			
Changing planting dates			
Changing size of land under cultivation			
Irrigation			
Reduce number of livestock			
Diversify from farming to non-farming activity			

SECTION G: HOUSEHOLD FOOD SECURITY

G1: Indicate the quantity of food crop you harvest in your farm per season/year

No	Food Crop	Quantity Per year (per 90kg)
I		
Ii		
Iii		
Iv		
V		

G2: Are you able to grow enough food to feed your family?

Completely insufficient [ ] not enough [ ] Sometimes [ ] usually [ ] Always [ ]

In case sometimes or less, what is the major constraint?_____
_____

G3: Does the household experience shortages of main food items?

Yes [ ] No [ ]

i) If no, what crops do you sometimes produce as surplus for sale?

_____

ii) If yes, how many food deficient months do you experience in a year?

Less than 3 months [ ] 4-5 months [ ] Over 5 months [ ]

G4: If yes, what are the reasons for food shortages? (Multiple responses allowed)

Drought [ ] Floods [ ] Lack of farm inputs [ ] Land not enough [ ]

Others_____

G5: Reduced Coping strategy index to measure household food security

Status of Household Food security	No. of times the strategy was adopted in a week(7 days)	Universal severity weight	Weighted Score =frequency x weight
i. Rely on less preferred and less expensive food		1	
ii. Borrow food or rely on help from friends and relatives		2	
iii. Limit portion size at mealtime		1	
iv. Restrict consumption by adults in order for small children to eat		3	
v. .Reduce number of meals eaten in a day		1	
TOTAL REDUCED (CSI)			

Appendix II: Key Informant Interview Guide

The researcher to lead the interviewees and probe as many information as possible in key areas of the study

1) What is the state of food security in west Pokot County (food availability, food accessibility, food utilization and food stability)
2) In regard to food security in west Pokot County, how does the following contribute to smallholder participation in smallholding farming
    a. Household income (acquisition of farm inputs, farming practices etc.)
    b. Land (Ownership, size of land under cultivation)
    c. Food crops cultivated by farmers
    d. Smallholder farming labour patterns
    e. The magnitude of time smallholders spend on their farm
    f. How does farmer association affect –food production, food preservation, pest and diseases, smallholder farm time (labour conditions)
    g. How does culture influence food security under the following-land under cultivation (land ownership), farming practices, household labour conditions, type of food crops, source and decision on household income.

Appendix III: Observation Guide

The study will be observing the following

i. Size of farm under cultivation

ii. Type of crops

iii. Extra labour on those farmers who will be on their farm

iv. Farming practices/technologies

v. Availability of food in the stores/granary

Appendix IV: Map of West Pokot County

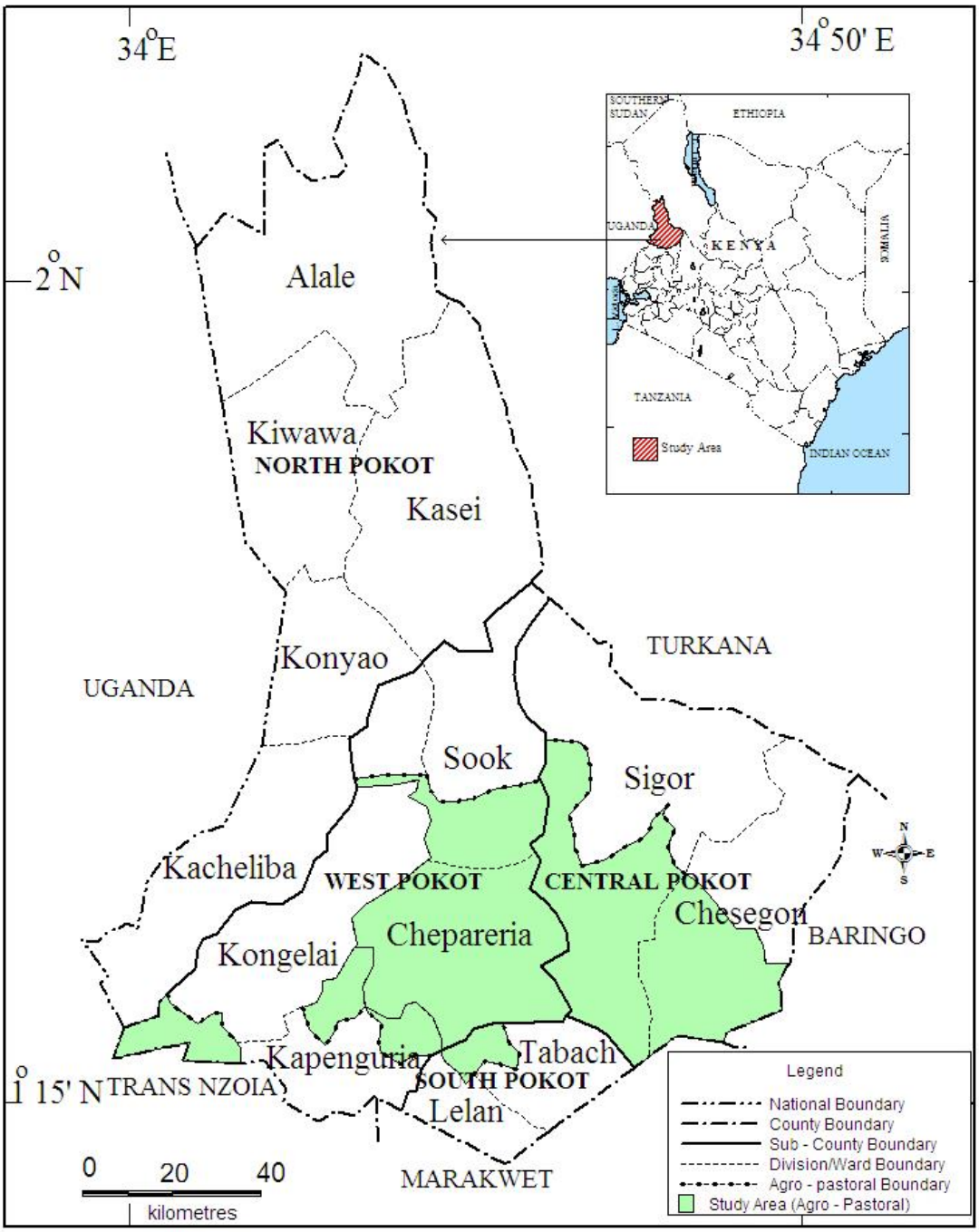

Figure 1: Map of West Pokot County showing contribution of small holder farmers to Household food security in Agro – pastoral zones.

Source: Moi University Geography Department GIS Lab.

Appendix V: Research Permit

THIS IS TO CERTIFY THAT:
MS. CAROLINE KATHURE GATOBU
of MOI UNIVERSITY, 0-50309
KAIMOSI,has been permitted to conduct
research in *Westpokot County*

on the topic: *CONTRIBUTION OF SMALLHOLDER FARMERS TO HOUSEHOLD FOOD SECURITY IN AGRO-PASTORAL ZONES IN WEST POKOT COUNTY, KENYA.*

for the period ending:
19th March,2020

Permit No : NACOSTI/P/19/59313/28646
Date Of Issue : 19th March,2019
Fee Recieved :Ksh 2000

.....
Applicant's Signature

.....
Director General
National Commission for Science, Technology & Innovation

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone:+254-20-2213471, 2241349,3310571,2219420
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Email: dg@nacosti.go.ke
Website : www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No. **NACOSTI/P/19/59313/28646**

Date: **19th March, 2019**

Caroline Kathure Gatobu
Moi University
P.O. Box 3900-30100
ELDORET.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Contribution of smallholder farmers to household food security in agro-pastoral zones in West Pokot County, Kenya"*** I am pleased to inform you that you have been authorized to undertake research in **West Pokot County** for the period ending **19th March, 2020.**

You are advised to report to **the County Commissioner and the County Director of Education, West Pokot County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

GODFREY P. KALERWA MSc., MBA, MKIM
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
West Pokot County.

The County Director of Education
West Pokot County.

THE PRESIDENCY
MINISTRY OF INTERIOR AND COORDINATION OF NATIONAL GOVERNMENT

Telegrams; DISTRICTER' Kapenguria
Telephone; kapenguria 054-62291
Radio call; kape 5ZRO
Email: ccwestpokot@gmail.com

County Commissioner
West Pokot County,
P.O. Box 1 – 30600,
KAPENGURIA.

REF: OOP.CC.ADM.15/14 VOL.1/248

26TH MARCH, 2019

TO WHOM IT MAY CONCERN

RE: RESEARCH AUTHORIZATION
CAROLINE KATHURE GATOBU

Reference is made to the letter Ref: No.NACOSTI/P/19/59313/28646 dated 19th March, 2019 on the above subject matter.

The above named person, is a student from Moi University - Eldoret, has been duly authorized to carry out a research on ***"contribution of small holder farmers to household food security in agro-pastoral zones in West Pokot County , Kenya"*** within West Pokot County for a period ending 19th March, 2020.

The purpose of this letter, therefore, is to request you to accord her your cooperation, guidance and necessary assistance she may require during her tour of research within the County as mentioned above.

(APOLLO O. OKELLO)
COUNTY COMMISSIONER
WEST POKOT COUNTY

CC

County Director of Education
WEST POKOT COUNTY

Appendix VI: Operationalization of Study Variables

Variable	Indicators	Operationalization	Hypothesis	Measurement Scale	Questionnaire Item
Socio-economic Factors	Household Income	Annual Income Amount spent on farming	**H_{01}**: There is no significant relationship between smallholder farmers socio-economic factors and household food security in West Pokot County	Ratio Scale Ratio Scale	B1 B2
	Land Ownership	Acreage under food crop		Ratio Scale	B5
	Education Level	Education Qualification		5 point Likert type scale	A3
Farming Characteristics	Farm Size	Acreage under food crop	**H_{02}:** There is no significant relationship between smallholder farming characteristics and household food security in West Pokot County	Ratio scale	C2
	Type of Food Crops	No of food crop		5 point Likert type scale	C4
	Farming Practices	Hybrid seeds Manure Chemical Fertilizer		5 point Likert type scale	C5 C6 C7
Household Labor conditions	Household labor	No of household in farming No of hours in farming	**H_{03}:** There is no significant relationship between smallholder farmers household labor condition and household food security in West Pokot County	Ratio scale Ratio Scale	D2 D3
	Free up of Women Time	No of women in farming Women time in farming		5 point Likert type scale	D2ii D3ii
	Extra Labor	Paid labor		5 point Likert type scale	D5
Climate Variability	Rainfall Pattern	Predictability	**H_{04}**: There is no significant relationship between climate variability and household food security in West Pokot County	5 point Likert type scale	Ei
	Temperature	Change in Temperature		5 point Likert type scale	E4ii
	Rain amount	Change Rainfall amount		5 point Likert type scale	E4iii
Farmers Associations X Socio-economic Factors	Farmer association in financial support	Amount received/farm input	H_{05a}: There is no significant moderating influence of farmer association on the relationship between smallholder socio-economic factors and household food security in West Pokot County	Ratio scale Ratio Scale	F5aiii F5avi
	Farmer association in capacity building	No of training			
Farmers Associations X Farming Practices	Farmer association in Mixed farming Farmer association Mixed crop Farmer association in pest & disease Farmer association in post harvesting	Frequency of support Frequency of support Frequency of support Frequency of support	H_{05b}: There is no significant moderating influence of farmer association on the relationship between smallholder farming characteristics and household food security in West Pokot County	5 point Likert type scale	F5bi

Farmers Associations X Household labor condition	Farmer association in farm labor	No of times per season	H_{05c}: There is no significant moderating influence of farmer association on the relationship between household labor condition and household food security in West Pokot County	5 point Likert type scale	F5cii
Farmers Associations X Climate Variability	Farmers association in adaption strategies	Change in rainfall pattern Change in rainfall amount Change in temperature	H_{05d}: There is no significant moderating influence of farmer association on the relationship between climate variation and household food security in West Pokot County	5 point Likert type scale	F5diii
Household Food Security	Availability Accessibility Stability Utilization	Quantity harvested per year Food sources Food throughout season Food allocation in household		Ratio Scale Ratio Scale Ratio Scale Ratio Scale	G1 G2i Giii G2iv

Appendix VII: Summary of the Objectives, Hypothesis, Analytical Model and Interpretation Of Results

Objective	Hypothesis	Independent Variable	Moderating Variable	Dependent Variable	Analysis model	interpretation
To examine the role of socio-economic factors on smallholder farmers contribution to household food security in West Pokot County	**H_{01}**: There is no significant relationship between smallholder farmers socio-economic factors and household food security in West Pokot County	X_1=μ(B1,B2,B5,A3) Where μ is mean		Y=μ(G1,G2i,G3iii,G2iv)	Simple Regression analysis $Y= \alpha + \beta_1 X_1 + \varepsilon$ Y= Household Food Security α= constant (intercept) β_1 = Coefficient parameters to be determined X_1= socio-economic factors ε = Error term	If R >0 then a positive relationship exists. If p value ≤ 0.05, then the relationship is significant.
To evaluate smallholder farming characteristics on household food security in West Pokot County	**H_{02}:** There is no significant relationship between smallholder farming characteristics and household food security in West Pokot County	X_2=μ(C2,C4,C5,C6,C7)		Y=μ(G1,G2i,G3iii,G2iv)	Simple Regression analysis $Y= \alpha + \beta_1 X_2 + \varepsilon$ Y= Household Food Security α= constant (intercept) β_1 = Coefficient parameters to be determined X_2= Household farming characteristics ε = Error term	If R >0 then a positive relationship exists. If p value ≤ 0.05, then the relationship is significant.
To analyse the role of farmers household labour conditions on household food security in West Pokot County	**H_{03}:** There is no significant relationship between smallholder farmers household labour condition and household food security in West Pokot County	X_3=μ(D2,D3,D2ii,D3iii,D5)		Y=μ(G1,G2i,G3iii,G2iv)	Simple Regression analysis $Y= \alpha + \beta_1 X_3 + \varepsilon$ Y= Household Food Security α= constant (intercept) β_1 = Coefficient parameters to be determined X_3 = household labor conditions ε = Error term	If R >0 then a positive relationship exists. If p value ≤ 0.05, then the relationship is significant.
To determine the influence of climate variability on smallholder farmers activities towards achieving household food security in West Pokot County	**H_{04}**: There is no significant relationship between climate variability and household food security in West Pokot County	X_4=μ(E4i,E4ii,E4iii)		Y=μ(G1,G2i,G3iii,G2iv)	Simple Regression analysis $Y= \alpha + \beta_1 X_4 + \varepsilon$ Y= Household Food Security α= constant (intercept) β_1 = Coefficient parameters to be determined X_1 = socio-economic factors ε = Error term	If R >0 then a positive relationship exists. If p value ≤ 0.05, then the relationship is significant.

	There is no significant relationship between smallholding farming and household food security in West Pokot County	X_1, X_2,X_3, & X_4		Y=μ(G1,G2i,G3iii,G2iv)	Multiple Regression analysis $Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$ Y= Household Food Security α = constant (intercept) X_4 = Climate Variability X_3= Household Labor Conditions X_2 = Smallholding farming characteristics X_1= Socio-economic Factors B_1- β_4- are the regression coefficients	If adjusted R^2 is > than individual R^2 values, then the joint influence is greater than individual influence If overall p value ≤ 0.05, then therelationship issignificant.
To examine how farmer association moderates socio-economic factors on smallholder farmers' contribution to household food security in West Pokot County.	H_{05a}: There is no significant moderating influence of farmer association on the relationship between smallholder socio-economic factors and household food security in West Pokot County	X_1=μ(B1,B2,B5,A3) Where μ is mean	Z=μ(F5aiii, F5avi)	Y=μ(G1,G2i,G3iii,G2iv)	Multiple Regression analysis: $Y = \alpha + \beta_1 X_1 + \beta_2 Z + \beta_3 X_1 * Z_1 + \varepsilon$ α =constant (intercept) β_1 = the coefficient relating the independent variable, β_2 = the coefficient relating the moderator variable, β_3 =The regression coefficient for the interaction term which provides an estimate of the moderation effect. $\beta_3 X_1 * Z$ = is the interaction term; product of the standardized scores for the independent variable and the moderator	If $\beta_3 X_1 * Z$ has a p value ≤ 0.05, then there is a significant moderating effect. B_3> 0 signifies positive moderating effect
To evaluate how farmer association moderates smallholder farming characteristics in West Pokot County	H_{05b}: There is no significant moderating influence of farmer association on the relationship between smallholder farming characteristics and household food security in West Pokot County	X_2=μ(C2,C4,C5,C6,C7)	Z=μ(F5bi)	Y=μ(G1,G2i,G3iii,G2iv)	Multiple Regression analysis: $Y = \alpha + \beta_1 X_2 + \beta_2 Z + \beta_3 X_2 * Z + \varepsilon$ α =constant (intercept) β_1 = the coefficient relating the independent variable, β_2 = the coefficient relating the moderator variable, β_3 =The regression coefficient for the interaction term which provides an estimate of the moderation effect.	If $\beta_3 X_2 * Z$ has a p value ≤ 0.05, then there is a significant moderating effect. B_3> 0 signifies positive moderating effect

					$\beta_3 X_2 * Z$ = is the interaction term; product of the standardized scores for the independent variable and the moderator	
To analyse how farmer association moderates farmers household labour conditions in West Pokot County	H_{05c}: There is no significant moderating influence of farmer association on the relationship between household labour condition and household food security in West Pokot County	$X_3=\mu(D2,D3,D2ii,D3iii,D5)$	$Z=\mu(F5cii)$	$Y=\mu(G1,G2i,G3iii,G2iv)$	Multiple Regression analysis: $Y = \alpha + \beta_1 X_3 + \beta_2 Z + \beta_3 X_3 * Z + \varepsilon$ α =constant (intercept) β_1 = the coefficient relating the independent variable, β_2 = the coefficient relating the moderator variable, β_3 =The regression coefficient for the interaction term which provides an estimate of the moderation effect. $\beta_3 X_3 * Z_1$ = is the interaction term; product of the standardized scores for the independent variable and the moderator	If $\beta_3 X_3 * Z$ has a p value ≤ 0.05, then there is a significant moderating effect. $B_3 > 0$ signifies positive moderating effect
To determine how farmer association moderates the influence of climate variability on smallholder farmers activities towards achieving household food security in West Pokot County	H_{05d}: There is no significant moderating influence of farmer association on the relationship between climate variation and household food security in West Pokot County	$X_4=\mu(E4i,E4ii,E4iii)$	$Z=\mu(F5diii)$	$Y=\mu(G1,G2i,G3iii,G2iv)$	Multiple Regression analysis: $Y = \alpha + \beta_1 X_4 + \beta_2 Z + \beta_3 X_4 * Z_1 + \varepsilon$ α =constant (intercept) β_1 = the coefficient relating the independent variable, β_2 = the coefficient relating the moderator variable, β_3 =The regression coefficient for the interaction term which provides an estimate of the moderation effect. $\beta_3 X_4 * Z$ = is the interaction term; product of the standardized scores for the independent variable and the moderator	If $\beta_3 X_4 * Z_1$ has a p value ≤ 0.05, then there is a significant moderating effect. $B_3 > 0$ signifies positive moderating effect