# AGRICULTURAL LAND USE AND ITS IMPLICATIONS ON HOUSEHOLD FOOD SECURITY IN KISII CENTRAL SUB-COUNTY, KENYA

A PhD Thesis Submitted to the Graduate School in Partial Fulfillment of the Requirements of the Degree of Doctor of Philosophy in Geography of Egerton University

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#### DECLARATION AND RECOMMENDATION

# **DECLARATION** This is my original work and has not been presented for a degree in any other university. Signed ..... Date..... Janepha Kemunto Kumba Reg. No. ND13/0137/05 RECOMMENDATION This PhD. Thesis has been submitted for Examination with our approval as the University supervisors. Signed ..... Date..... Prof. Francis N. Wegulo Department of Geography, **Egerton University** Signed ..... Date..... Dr. Joseph Otieno Department of Geography, **Egerton University**

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# **DEDICATION**

This thesis is dedicated to my late parents, Mr and Mrs Gideon and Hellen Kumba who laid the foundation for my education.

#### **ABSTRACT**

Agricultural land is an important resource for farm households as it forms the base for their livelihoods. Therefore, the manner in which households utilize this resource influences to a large extent their food security situation. This study sought to establish the impact of agricultural land use on household food security in Kisii Central sub-County, Kisii County. To achieve this objective the study focused on the following; examination of the various land use activities, assessment of the food security situation of households, establishment of the relationships between agricultural land use and household food security and finally determination of the influence of household socio-economic characteristics on agricultural land use and household food security in the study area. Agricultural land use was conceptualized as consisting of four categories namely; cash crop, food crop, fruits and vegetables and pasture and napier grass while household food security was assessed using Experience-based method. The sampling frame comprised all rural farm households in Kisii Central sub-County within the LH<sub>1</sub>, UM<sub>1</sub> and LM<sub>2</sub> agro-ecological zones. The sub-Location with the highest population density within each agroecological zone was selected and a stratified random sample of 209 respondents was picked. A structured questionnaire was used to collect data from farm household heads. Data was analyzed using the Statistical Package for Social Sciences (SPSS version 17.0). Descriptive statistics provided statistical summaries while Pearson's Chi-square test was used to establish the relationship between agricultural land use and household food security and also analyze the influence of household socio-economic characteristics on agricultural land use and household food security. Results from the study showed that agricultural land was allocated as follows; food crop (65%), cash crop (25%) and others (10%). Most households were food secure (77.5%). Cash crop (p=0.000) and pasture / napier grass (p=0.002) were found to be significantly related to household food security. The socio-economic characteristics that had a significant influence on agricultural land use and household food security were the level of education of household head, farm size and household income. The study recommends that efforts should be put in place to boost household income through efficient utilization of the land resource in the production of both food and cash crops in order to ensure household food security within the study area.

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#### LIST OF ABBREVIATIONS AND ACRONYMS

AFSUN - African Food Security Urban Network

CBS - Central Bureau of Statistics

DFID - Department for International Development

EPTD - Environment and Production Technology Division

FAO - Food and Agriculture Organizations

FEWS NET - Famine Early Warning Systems Network

GDP - Gross Domestic Product

GHI - Global Hunger Index

ICRA - International Centre for Research in Agro forestry

IFAD - International Fund for Agricultural Development

IFPRI - International Food Policy Research Institute

KFSM - Kenya Food Security Meeting

KFSSG - Kenya Food Security Steering Group

KIHBS - Kenya Integrated Household Budget Survey

KTDA - Kenya Tea Development Authority

LH - Lower Highland

MDG - Millennium Development Goals

MT - Metric Tones

NCPB - National Cereals and Produce Board

NDES - National Dietary Energy Supply

SGR - Strategic Grain Reserve

SLF - Sustainable Livelihood Framework

SRA - Strategy for Revitalizing Agriculture

SSR - Self-Sufficiency Ratio

UM - Upper Midland

UN - United Nations

UNFCCC - United Nations Framework Convention on Climate Change

WFP - World Food Programme

# CHAPTER ONE INTRODUCTION

### 1.1 Background to the Study

Access to food was declared a human right in 1948 upon the Universal Declaration of Human Rights (UN, 1949). The right to adequate food is realized when "every man, woman and child, alone or in a community with others, has physical and economic access, at all times, to adequate food or means for its procurement" (CESCR, 1999). The right to food is a right to feed oneself in dignity and individuals are expected to meet their own needs through their own efforts using their own resources (UN, 2010). The right to food is also echoed by the Constitution of Kenya, 2010 under the Bill of Rights which states that every person has the right to be free from hunger and to have adequate food of acceptable quality (RoK, 2010).

According to FAO (2009), the right to food as a human right gives food security the 'human face' by placing individuals at the centre of approaches to food security. Despite this, the achievement of food security has been a challenge especially in the developing world. In 2010, the Food and Agricultural Organization (FAO) estimated that more than 900 million people globally were suffering from hunger (FAO, 2010). Reports show that there has been improvement on the food security situation globally as the number of those faced with hunger reduced from 868 million to 842 million (12% of the world's population) between 2011 and 2013 (FAO, IFAD and WFP, 2013). A recent report shows a further reduction of food insecure people to 805.3 million (11.3% of the world population) between 2012 and 2014 (FAO, IFAD and WFP, 2014). However, more than 2 billion people worldwide are affected by hidden hunger as a result of deficiencies in essential micronutrients such as Iron, Vitamin A and Zinc and about 25% of the children under the age of 5 years (162 million) are stunted (FAO, 2013). Global efforts to reduce hunger were initiated after the food crises of the early 1970s and in 1974 the first World Conference on food was convened by the FAO to address the situation. During the conference, nations pledged to ensure availability at all times of adequate food supplies (of basic foods) so as to avoid hunger (FAO, 1974). The result of these efforts have been varied; over the last two decades, food supplies have grown faster than population in developed countries resulting in rising food availability per person and dietary energy supplies have also risen faster than average dietary energy requirements (FAO, 2014). The developing world has experienced

some improvements in relation to the proportion of those undernourished but despite this, 827 million of the those undernourished (98.2%) live in developing countries mostly in Southern Asia (34.3%), sub-Saharan Africa (26.6%), Eastern Asia (20%) and to a lesser extent, South East Asia (7.9%) and Latin America and the Caribbean (4.6%) according to recent studies (FAO, IFAD, WFP, 2014).

Many countries in Eastern Asia have benefited from continuous and rapid economic development which has led to great improvement in their food security situation but sub-Saharan Africa lags behind (FAO, 2014; FAO, 2013). Food insecurity in the sub-Saharan Africa region continues to deteriorate due to several reasons. The first reason is that population is increasing fast (at a growth rate of about 2.5%) and it is estimated to reach 1.2 billion by 2025 (Diao et al., 2012). Rapid population growth if unchecked will have negative implications on natural resource use and food availability. The second problem is low agricultural productivity. Studies indicate that cereal yields are low, averaging between 1500Kg/per ha. and 2000 Kg/per ha. which is way below the world average of about 3000Kg/per ha. (Oxford Analytica, 2009). Yields of staples such as maize are only about 30% to 50% of what they could be with proper application of fertilizers and seeds among other inputs (World Bank, 2007). Therefore, based on the current agricultural productivity rates, sub-Saharan Africa is expected to meet only 25% of its food needs by the year 2030 (Global Agricultural Productivity Report, 2013). The third challenge to food security in sub-Saharan Africa is the high rate of poverty. Over 40% of the population live on less than 1.25 US dollars a day and this proportion has not changed much over the last decade as opposed to other regions like East and South Asia (Deutsche Bank, 2014). Food accounts for a major part of expenditure for poor households, therefore, lack of income directly affects their food security. Inadequate access to land is also a critical challenge to food security in sub-Saharan region. Africa and Asia are the only continents where average farm size has declined over the past four decades, and in sub-Saharan Africa, average farm size is about 2.16ha. and per capita access even lower (0.12ha.) leading to over sub-division of land into uneconomic units and low productivity (Jayne, Marther and Mghenyi, 2010). Food security is also affected by many other factors most of which are interlinked and include; poor food distribution, climate change, increased demand for bio-fuels, unstable social and political

environments, natural resource constraints (e.g. water), poor human resource, increase in food prices, loss of crop diversity and urban sprawl among others (Olimar, 2011).

Kenya like other countries in sub-Saharan Africa has problems with food security. In 1961, Kenya could feed 8.4 million people at more than 10% above WHO requirements assuming that basic foods contributed 75% of the dietary energy and this was because basic food production was high in terms of area harvested and yields (Dietz, 2014). During the 1980s, the harvested area and crop yields stabilized resulting in Kenya being largely self-sufficient in food but in 1990s, yields deteriorated for all basic food crops such that in the year 2000 the amount of food being produced could only feed 68% of the population (Ibid). The Kenya Integrated Household Budget Survey of 2005/06 indicated that 47.2% of people in the rural areas had food consumption levels that were insufficient to meet their basic daily energy requirement of 2250 Kilocalories per adult equivalent per day. Several reports indicate that production of the basic food crops has not kept pace with food demand, for example, in 2008, about 1.3 million people in the rural areas and between 3.5 to 4.0 million in the urban areas were food insecure and the number increased to 10 million in the past few years with 3.2 million living in arid and semi-arid areas (IFPRI, 2012; WFP, 2009).

Household food insecurity in Kenya is attributed to factors such as decline in food production due to low agricultural productivity as a result inadequate use of inputs. For example, average application of fertilizers in Kenya is about 30 Kg/ha/year which is far less than the world average of 100 Kg/ha/year (Ariga, Jayne and Nyoro, 2006). High poverty level (45.9% in 2005/06) also contributes to household food insecurity because the poor are not able to access food because they cannot afford it, this has implications on household well-being given that 53.9% of the food consumed in the rural area is purchased (KNBS, 2005/06). Limited access to land is another constraint to the achievement of household food security. Cultivated land per person in Kenya declined from 0.462 ha in 1960s to 0.219 ha between 2000 and 2008 resulting in 0.04ha. *per capita* (Jayne and Munyanga, 2012). This amount has further declined and by 2011 total arable land per person was 0.13 hectares (Trading Economics, 2014). The small size of farms is therefore a constraint to poverty alleviation because small farms reduce the potential to produce surpluses leading to low incomes. Although farm productivity and incomes tend to rise with population density; beyond a certain threshold (600 - 650 persons/Km²), rising

population density is associated with sharp declines in farm productivity, total household income and asset wealth (Omosa, 1998). Already, this has become a reality in Kenya because about 14% of the rural population in the high agricultural potential regions such as Kisii Central sub-County has exceeded this population density (Ibid).

Kisii Central sub-County's agricultural land use is dominated by production of food and cash crops. A farm survey conducted in 2004 by the Ministry of Agriculture (and reported by Jaetzold *et al.*, 2009) indicated that most of the land was used for production of food crops, particularly maize and beans. The other crops of importance are tea, coffee, napier grass and bananas (Jaetzold *et al.*, 2009). Crop farming is not the only agricultural activity, rearing of livestock is also practiced and over 70% of farmers in Kisii keep cattle with low cattle *per capita* of 0.2 due to land scarcity, as a result, zero grazing and rearing of hybrids have been encouraged to increase productivity (Ibid).

Kisii Central sub-County like the rest of Kenya also faces problems of household food security. Studies conducted in the 1980's indicated that most households could not produce enough food without help from non-agricultural income invested in purchasing land and intensifying its use (Raikes, 1990). A study by Omosa (1998), found that 31% of the households exhausted their harvested food within 6 months after harvest and only 12% of the households had food that lasted a full year. The same study showed that about 63% of small scale farmers depended on the market for additional food, and that up to 50% of their food requirements had to be met from outside domestic production. Household food security has continued to deteriorate over the years, for example, between 2011 and 2012, Kisii Central sub-County and the surrounding region (the then Nyanza province) experienced a deficit of about 1.4 million bags of maize which meant that 40% to 60% households in Kisii Central sub-County had to buy their cereals from outside the region at exorbitant prices (KFSSG, 2011).

Household food insecurity in Kisii Central sub-County has been attributed to many factors the main one being the diminishing land resource due to high human population growth, hence pressure on land for crop and forage production (KFSSG, 2012). The land holdings are small, averaging about 0.5ha (1.24 acres) although most of the farms in parts of the sub-County such as Kiogoro, Keumbu and Mosocho divisions are associated with even smaller farm sizes of between 0.7 to 1 acre (Kisii Central, 2008). According to the Kisii Central District Development

Plan (2008 - 2012), the area was expected to have an average population density of 1056 persons/km² by 2012, a situation that could threaten food production as arable land has been reduced due to land sub-division and allocation to non-agricultural uses such as construction of settlements. The high population growth of 2.75% per annum (CBS, 2001a) is associated with high demand for food and other basic necessities. Soil fertility has declined due to continuous cropping because of the inability of farmers to set aside land for fallow even for a season because of the small farm sizes (Place *et al.*, 2004). This has a negative impact on food production as most food crops are associated with low yields the problem is further compounded by use of low levels of yield enhancing inputs for both food and cash crops, resulting in low levels of crop income (Dietz, 2014). Kisii Central sub-County also has high poverty levels that influence agricultural production and household food security. The rural poverty rate is about 54.2% and the proportion of the population which was considered food poor was about 52% by the year 2008 (Kisii Central, 2009).

Land utilization is critical to the understanding of food security and its links to poverty particularly in areas like Kisii Central where the threshold of the land carrying capacity has been exceeded partly because new techniques of production are not always applied. This study therefore, sought to determine the implication of agricultural land use on household food security in Kisii Central sub-County.

#### 1.2 Statement of the Problem

This study focused on the implication of agricultural land use on household food security in Kisii Central sub-County, Kisii County, Kenya. Although the area is situated in a high agricultural potential region of Kenya, it is associated with a high food poverty rate (52%) as indicated in the Kisii Central District Development Plan of 2008-2012. The problem of food insecurity persists despite the fact that most of the agricultural land is allocated to food production and given the fact that household food security is determined by factors such as domestic food production and household income, the implication is that households are expected to meet their food needs by either growing it themselves or through purchase. For rural households majority of whom are poor, cultivation holds a central role as a source of food and income. Land utilization, therefore, becomes an important determinant of food availability and other forms of livelihoods. According to Kenya Integrated Household Budget Survey of 2005/06,

53.9% of the food consumed by rural households in Kenya is purchased. The purchasing power of households is tied to, or limited to the level of farm income which in turn is determined by farm size and productivity of agricultural activities. Kisii Central sub-County has a high population density (1056 persons per Km²) which has created immense land pressure resulting in the average farm size of about 0.5ha for household sizes of about five people. Availability of land and its utilization are important determinants of agricultural production and therefore, efforts to develop agriculture so as to achieve food security should be based on clear understanding on how farm families allocate their land amongst competing farm enterprises and how these allocations influence the food security status of the households.

Most studies on food security in the study area have focused on causes and extent of food insecurity. No studies (known to the researcher) have been done to determine the impact of agricultural land use on food security at household level in Kisii Central sub-County. This study was therefore designed with the hope of bridging the knowledge gaps as described.

## 1.3 Objectives of the Study

The main objective of this study was to analyze various agricultural land uses and their impact on household food security situation in Kisii Central sub-County with the view of establishing those with significant impact on household well-being. The following were the specific research objectives.

- 1. To examine the various types of agricultural land use activities in the study area.
- 2. To assess the food security situation of households in the study area.
- 3. To establish the relationship between agricultural land use and household food security situation in the study area.
- 4. To determine the influence of household socio-economic characteristics on agricultural land use and household food security situation in the study area.

## **1.4 Research Questions**

- 1. Which are the main agricultural land use types in the study area?
- 2. What is the status of household food security in the study area?
- 3. How does agricultural land use affect household food security in the study area?

4. How do household socio-economic characteristics influence household food security and agricultural land use in the study area?

## 1.5 Justification of the Study

The Constitution of Kenya, 2010 under the Bill of Right states that every person has a right to be free from hunger and to have adequate food. The right to food is a human right therefore in order to enjoy this right individuals must be enabled to utilize their efforts and resources to access it. This research provides information on household food security situation and the general material well-being of households against their overall social, economic and environmental setting. This information will help in formulation of agricultural policies that would enhance food security through coordination, monitoring and management of food and non-food production among the small-scale farmers. Initiatives by government to improve food security will depend on the understanding of the existing production patterns, attitudes and constraints at the household level. It is only then that they can be scaled up to regional and national levels.

Food insecurity, poverty, unemployment and low economic growth are some of the challenges facing Kenya. Among the strategies that the government of Kenya has put in place to tackle some of the challenges is development of small-scale agriculture which accounts for about 75% of total agricultural production and employs over 75% of the work force. This study, therefore, seeks to provide an understanding on the dynamics of land utilization which will enable the local community and the central and county governments to strategize on how best to utilize land in order to ensure increased agricultural productivity and food security.

Vision 2030 through the Economic Pillar proposes a 10% annual economic growth and this can be actualized if the agricultural sector's growth is accelerated. This can only be possible if the agricultural sector is well understood therefore this study provides background information on agricultural activities in a high agricultural potential area which can be used to direct policy on strategies of improving agricultural productivity in areas faced with high population growth, high population densities, limited arable land and other environmental challenges.

The selection of Kisii Central sub-County was based on the fact that the area though situated in a high agricultural potential region continues to experience household food insecurity. In addition, a large proportion of small-scale farmers (63%) depend on purchased food and given

the high poverty levels in the area this situation is not sustainable. The area also has one of the fastest population growth rates (2.75% per annum) and high population density (1056 person /Km²) implying that there is an enormous pressure on land resulting in small farm sizes. Soil fertility has also declined due to intensive cropping and limited use of fertilizers which has resulted in low agricultural productivity. A basic understanding of land utilization at the household level is therefore critical in solving problems of agricultural productivity and food security in the study area.

The Kisii County has a new administrative unit lacks substantial literature on agricultural land use and household food security. This study therefore provides relevant background information that provides a base from which future studies may take off.

#### 1.6 Scope and Limitations of the Study

The study focused on households engaged in farming within the Kisii Central sub-County of Kisii County. The main purpose of the study was to determine the implication of agricultural land use on household food security. In addition, the study explored the state of household food security and also the impact of household socio-economic characteristics on agricultural land use and food security. The study was also limited to the representative samples picked from three sub-Locations with the highest population densities within the three agro-ecological zones of the area.

One of the limitations of this study was associated with the Experience-based method of assessing food security situation at the household level and the reason is that some household heads may deliberately give inaccurate answers with the aim of gaining assistance. This limitation was mitigated by using probing questions on the amount of food required in the household, domestic production of food and amount purchased within specific periods.

Challenges in answering questions also emerged in some of the sections related to farm allocation, farm incomes and food consumption levels. Efforts were made to simplify the questions during interviews and some had to be explained over and over again in order to get accurate answers and this took a lot of research time. Some of the reasons for these challenges were due to problems of recalling data and poor record keeping at the farm level. Despite this, efforts were made to assist respondents in remembering some of the information and also use of the available records.

The study was also constrained in the collection of information on gender issues. Female headed households (whether *de facto* or not) were reluctant to provide information without the presence of a male relative. This was overcome by explaining the purpose of the study and also allowing male family members to be present (but not participate) during the administration of the questionnaire. Also, utilization of research assistants from the local area helped in boosting confidence in the respondents who were able to provide the necessary information.

### 1.7 Assumptions of the Study

This research was based on various assumptions. First and foremost, the study assumed that agricultural land use has an impact on household food security in the study area. This leads to the second assumption that other factors such as environmental and political ones (intervening variables) did not have a highly significant influence on household food security during the study period. Thirdly, it was assumed that household socio-economic characteristics influence agricultural land use and household food security. The study was also based on the assumption that the other socio-economic factors not included in the study did not change sufficiently during the period of study to significantly affect agricultural land use and household food security situation.

#### 1.8 Operational Definitions of Terms and Concepts

**Household food security:** This was defined as the state of food availability at the household level based on all sources of food namely; 'own production', 'purchasing', 'working for food' and 'gifts in form of food' in a period of 12 months preceding the study. Food secure households were those who had adequate food throughout the 12 month period or those who experienced a mild shortage lasting 1 to 2 months, and were able to cope with the shortage by skipping a meal or by early harvesting of food. Households considered to be food insecure were those who experienced food shortages lasting 3 months and more.

**Food poverty**: Is the inability to afford, or to have access to food to make up a healthy diet, it is about the quality of food as well as quantity.

**Agricultural land:** This study considered all land under cash crops, food crops, fruits and vegetables, and natural pasture and napier grass as comprising the agricultural land.

**Agricultural land use:** This referred to the manner in which agricultural land was apportioned for different activities by farm households. These activities were grouped together into four land uses namely; cash crop, food crop, fruits and vegetable, pasture and napier grass.

**Cash crop land use:** This referred to all the land used for the production of the following crops; tea, coffee and sugarcane.

**Food crop land use:** This included all land under food crops like maize, beans, bananas, sorghum, finger millet and sweet potatoes.

**Fruit and vegetable land use:** This referred to all the land used to grow fruits and vegetables namely; avocadoes, pineapples, paw paws, cabbages, kales, onions and traditional vegetables amongst others.

**Pasture and napier grass land use:** This referred to all land under natural pasture and also the land under napier grass.

**Household:** It referred to all persons who occupy a housing unit or a group of persons who live together in the same compound or dwelling unit and share the same sleeping and cooking facilities. Household size was defined as the number of people living in the household.

**Household head:** The head of the household is a person of either sex who runs the affairs of the household and is looked upon by the other members as the main decision maker. This study considered male farm owners as household heads or female spouses who had been left in charge of households as *de-facto* heads as the husbands worked outside the farms. *De facto* female headed households were those where the male head was absent most (>50%) of the time. Those widowed, single, divorced and separated were also considered as the heads of households.

**Livelihood:** Is defined as adequate stocks and flows of food and cash to meet basic needs (Chambers, 1988). Agricultural activities were considered as the main sources of livelihood for most households in Kisii Central sub-County.

**Undernourishment:** FAO estimates of prevalence of undernourishment are based on calculations on the amount of food available in each country National Dietary Energy Supply (NDES) and a measure of inequality derived from household income or expenditure surveys. No calculations on household undernourishment levels were undertaken and the FAO estimates were used as reported in various literature.

**Endowment set:** Is defined as a combination of all resources legally owned by a person. Resources include both tangible assets such as land, equipment, animals and intangibles such as knowledge, labour or membership of a particular community (Sen, 1981).

**The Entitlement:** Is defined as the set of all possible combinations of goods and services that a person can legally obtain using resources like land, equipment, labour, knowledge and many more.

**Entitlement mapping:** Is the relationship between endowment set and the entitlement set.

It shows the rates at which resources of the endowment set can be converted into goods and services included in the entitlement set (Sen, 1981).

**Access to land:** In this study, access to land referred to all the land available for household use through inheritance, buying or leasing.

**Agricultural Policy:** It describes a set of laws relating to domestic agriculture and imports of foreign agricultural products. Agricultural policies are developed with the goal of achieving a specific outcome in the domestic agricultural product markets.

#### 1.9 Organization of the Thesis

This thesis contains five chapters. The first chapter has presented an introduction to the study. Chapter two is devoted to the review of literature relevant to the study. It also includes the theoretical and conceptual frameworks. The research methodology section is contained in chapter three. Results and related discussions are presented in chapter four, and finally, the fifth chapter provides a summary of key findings, conclusion and recommendations.

#### CHAPTER TWO

#### LITERATURE REVIEW

#### 2.1 Introduction

This chapter highlights literature related to the research topic in reference to the objectives of the study. The first section is a discussion of the concept of food security and its dimensions. Section two presents a review of literature on the following; food security issues with emphasis on factors which influence household food security globally and locally, agricultural land use and household food security, and finally, the impact of households' socioeconomic characteristics on agricultural land use and household food security. The discussion of the theories that explain food security, conceptual framework and gaps in literature have been presented at the end of the chapter.

## 2.2 The Concept of Food Security

The international community was first drawn to the issue of food security in the year 1948 upon the Universal Declaration of Human Rights when access to food was declared a human right (UN, 1949). The food crises of 1972 to 1974 further renewed interest in the issue, and in 1974 the first world conference on food was convened by the Food and Agricultural Organization (FAO) of the United Nations (UN) whose theme was food security (FAO, 1974). The FAO delegates agreed on the need to ensure availability at all times of adequate world food supplies of basic foods so as to avoid shortages or hunger. In the mid 1980's the gravity of the world economic crisis and its widespread effects particularly on poor nations led FAO to reappraise this concept. The World Summit in 1996 adopted a new definition which states that "food security is a situation 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 a healthy and active life" (FAO, 1996). This definition conceptualizes food security at different levels; individual, household, national and global. It also identifies four main dimensions; food availability, accessibility, utilization and stability of food supplies.

The physical availability of sufficient food addresses the quality and quantity of food supplies, the capacity of a nation to import food, food stocks, food aid and net trade (FAO, 2008). Food may also be availed through domestic food production which depends on a number of factors among them agro-ecological conditions of an area (Kuwornu *et al.*, 2011).

Access to food is due to entitlement through purchases, exchange and claims. Individuals can access food if they have enough resources in form of income from sources such as salaries, remittances from household members or exchange for their labour. To ensure physical access to food, adequate amount of food must be within reach by all people through their own production and through purchase. Concerns about insufficient food access have led nations to focus on incomes, expenditure, markets, prices and food distribution systems in order to achieve their food security objectives (FAO, 2008).

Food utilization as a concept relates to the ability of the human body to physiologically absorb nutrients in the food. This means proper biological use of food with a diet that contains energy and nutrients as well as knowledge of basic nutrition. This dimension of the definition goes beyond the food to non-food issues and includes good care and feeding practices, food preparation, intra-household distribution of food among many more factors. Food safety impacts on food utilization and is influenced by sanitation and access to clean water (Gregory *et al.*, 2005; FAO, 1997).

Stability of household food supplies depends on the ability of a household to procure food through income, production and transfers adequate food on a continuing basis even when they are faced with unpredictable shocks or crises (FAO, 1997). Stability, therefore, relies on improved productivity, weather variability, seasonality, political factors, economic factors and available proper storage (Kuwornu *et al.*, 2013). It is determined by the household's ability to cope with or minimize the extent and duration of the effects of food shortages.

Food insecurity, a situation that can exist when people do not have enough food (both in quality and quantity) can either be chronic or transitory. FAO (2008) makes a distinction between the two and indicates that transitory food insecurity is short-term and temporary, and is a result of inability to produce or access enough food. This sometimes happens when there is a fluctuation in food availability and access due to fluctuation in domestic food production, increase in food prices and a decline in household incomes. Transitory food insecurity is therefore a result of unpredictable circumstances although households may also suffer from seasonal food insecurity when there is a regular pattern in the recurrence of inadequate access to food.

Chronic food insecurity on the other hand, occurs when households continually run the risk of being unable to meet the food needs of all household members (FAO, 2008; FAO, 1997). It is long term or persistent and occurs when people are unable to access their minimum food requirements over a long period of time. It results from poverty, lack of assets and limited access to productive resources. Food insecurity is therefore multifaceted and is caused by various factors some of which are interconnected (Moharjan and Chhetri, 2006).

Food security is an elusive concept and the multidimensional nature of phenomenon poses considerable challenges to researchers in terms of operationalizing the concept (Barret, 2010). Assessment methodologies vary from qualitative to quantitative methods and studies have provided insight into the experience of households with regard to food insecurity (Mgotto *et al.*, 2006). These include feelings of anxiety of food shortage, perception that food is of insufficient quantity, reported reduction of food intake and perceptions about the quality of food (Radimer *et al.*, 1992; Radimer *et al.*, 1990). Mgotto *et al.* (2006) identify five general types of methodologies used to measure food insecurity namely; measuring undernourishment, measuring food intake, measuring nutritional status, measuring food access in terms of income, and measuring vulnerability. These methodologies are operationalized by estimations of calories available *per capita* at the national level, household income and expenditure surveys, individual's dietary intake, anthropometry and experience-based food insecurity measurement scales (Hoddinott, 1999). Mallick and Rafi (2010) argue that consumption-based methodologies are susceptible to errors because of the large seasonal variability in food availability and that use of consumption data may systematically under or over report the true food security.

According to Barret (2010), measurement issues related to the 'access' dimension to food security are the most difficult because they are multifaceted among the three pillars of food security. Despite the fact that both calorie-based and experiential indicators measure access to food, there is a subtle difference; experienced-based indicators measure economic access to food and look at food insecurity more as a socio-economic condition leading to unequal access to food, consistent with Sen's (1981) entitlement approach (Ballard *et al.*, 2013). This study used the experience-based measure to assess household food security in the study area partly because of its relation to Sen's entitlement model which forms the base of the conceptual framework of the study, and partly because of its ability to identify food insecurity at household level. Despite

its strengths, it faces challenges mainly concerned with response bias and obscurity in deciding cut-offs to classify the food insecure population into various categories by the severity of food insecurity (Maitra and Rao, 2014).

#### 2.3 Food Security Issues

The African Continent faces two main challenges in the 21<sup>st</sup> Century; how to feed the growing population and how to adapt to changes in climate (Seiler, 2013). A report by FAO (2010) showed that 925 million people globally (which was about 13.5% of the world population) suffered from hunger. Most of those facing hunger were in the developing world with Asia / Pacific leading with the highest proportion (62%) followed by sub-Saharan Africa (26%) and only 2% were found in the developed world. This situation influenced FAO's view that the Millennium Development Goal No.1 objective of reducing the proportion of people faced with extreme hunger and poverty to about 8% of the population by 2015 is unattainable in most developing countries. Food insecurity in sub-Saharan Africa is a major concern and the region has not been able to produce enough food to feed its population for a long time now.

Earlier studies (IFPRI, 1995; FAO, 1994) indicated that while population growth for sub-Saharan region was about 2.7% per annum, the average growth of agriculture was between 1.7% and 1.9% per annum between 1965 and 1980. The gap between growth in agriculture and population narrowed after 1980, but this did not improve the situation of food insecurity as projections indicated that on the basis of food production trends, sub-Saharan Africa would be able to feed from domestic sources, just about half of its population by the year 2020 (Maxwell, 1992). According to Bremner (2012), the food situation in sub-Saharan Africa is critical, about 240 million people (1 in every 4) lack adequate food for a healthy and active life and about 30 million children in sub-Saharan Africa are underweight. The demand for food in sub-Saharan Africa will continue to increase because almost 40% of the population is below 15 years of age and is yet to enter the reproductive stage (Bremner, 2012).

Although sub-Saharan Africa does not need to produce all its food to become food secure because it can import some of the required food, this may not be possible. Hunger and poverty are closely related and while sufficient income to purchase food is a major factor causing household food insecurity, hunger itself contributes to poverty by lowering labour productivity

and reducing resistance to disease (IFPRI, 2013). It is estimated that about 48.5% people live in poverty in sub-Saharan Africa (World Bank, 2013).

The other cause of food insecurity is inadequate food production at household level because globally, arable land per capita is declining due to continuing population growth and land degradation and estimates show that by the middle of the 21<sup>st</sup> Century there will be about one third (1/3) as much cultivable area per person as 100 years earlier, a decline from 0.25ha to 0.08ha per person (Uploff, 2012). This situation is bound to worsen the food situation in sub-Saharan Africa because almost two out of every three people live in rural areas relying principally on small-scale agriculture for their livelihoods (Ibid). Already about 80% of farms in Africa are less than 2 hectares and these farms are becoming smaller as farmers sub-divide agricultural land among their children and this is making rural people more vulnerable to food insecurity because it is almost impossible to improve small scale agriculture which is critical to reducing hunger (FAO, 2010).

Climate change and global warming are also considered major threats to agriculture and food security. According to UNFCCC (2007), natural climate cycle and human activities have resulted in an increase in the accumulation of heat-trapping green house gases in the atmosphere hence contributing to increase in temperature causing global warming. Increases in maximum temperature and extreme weather events associated with such increases makes it difficult for farmers to plan their operations, may lead to a reduction in the cropping season, low germination, reduced yield and crop failure leading to food insecurity (Thornton and Lipper, 2014). Global warming affects crop productivity and an increase of 1 - 2°C is expected to cause a reduction of up to 50% of yields by the year 2020 (IPCC, 2007). It is expected that the impact of climate change will be felt most by African economies because they are predominately agrarian and depend on the vagaries of weather and due to inability to cope as a result of poverty, low technical development and low cropping capabilities by farmers (Onyenechere, 2010; Ziervogel et al., 2006). According to FAO, over 12 million people in the horn of Africa (Somalia, Ethiopia, N/Eastern Kenya) are susceptible to frequent starvation because the area has experienced some of the worst droughts in recent decades (FAO, 2011).

Climate change is expected to trigger price increases of over 100% on the main global food staples (maize and paddy rice) by the year 2030 (Sasson, 2012). These cereals are the basic

staples for majority of the global population. In view of this, prices for food will be well beyond the means of most people in the world, especially the poor. Already, the current price of food is said to have a negative impact on food security and a list by FAO of thirty (30) countries for which the soaring price of food has a dramatic effect includes Kenya and its neighbours; Uganda, Ethiopia, Somalia and Sudan (FAO, 2011). To adapt to climate change and ensure food security, major interventions are required to transform present patterns and practices of food production and distribution and the current scientific community has a role to play in providing information on climate resilient agricultural production systems (Beddington *et al.*, 2012).

It is widely accepted that poverty is currently the principal root cause of food insecurity at the household level and that reducing poverty and ensuring food security are among the most important Millennium Development Goals (UN, 2000). About 40% of the world's population (2.6 billion) live on less than two dollars per day and 925 million people lack sufficient purchasing power to access enough calories to sustain a medium level of physical activity (Thompson-Gardner, 2014). Poverty and food security are complex and multidimensional in nature; poverty leads to under-nutrition and food insecurity by limiting people's access to food and food insecurity also causes poverty, vulnerability and livelihood insecurity but it is at the same time also a result of these conditions (Sharma, 2012). Poverty acts as a catalyst of food insecurity because it constraints the ability of farming households to invest in productive asset and agricultural technologies resulting in insufficient agricultural productivity (Frimpong, 2013).

Armed conflict is another notable cause of food insecurity and poverty. This is because violence and social conflicts have a direct and immediate impact on food and nutritional status of individuals due to human displacement resulting in disruption of the production capacity, livelihoods and access to food (Messer *et al.*, 2001). According to Maxwell (2012), out of the twenty countries receiving the most humanitarian aid (food assistance and otherwise) since the year 2000, eighteen of them have been involved in some kind of internal conflict. The Sahel region of Africa has a population of about 125 million people who include some of the poorest in the world with undernourishment levels of up to 65% (Eritrea) and part of the reason is that most Sahelian countries (six out of the nine) were involved in armed conflicts in 2012 (UNHDRO, 2013). Studies indicate that people currently living in countries affected by violence are twice as likely to be undernourished and 50% more likely to be impoverished (World Bank, 2011b).

Africa is home to 38% of the worlds' displaced people (13 million in 2011) who include refugees, Internally Displaced People (IDPs) and returned refugees most of whom live in extreme poverty (UNHCR, 2012). However, food insecurity can also be a cause of violent conflict; for example, the mass uprisings of the Arab Spring (2007- 2008) and the unrests experienced in some urban areas of the developing world in the same period were food price related (Hendrix and Brinkman, 2013).

Food price movements in global and regional markets also have a significant impact on food security (Hajkowicz et al., 2012). From 2003 to 2007 the number of under-nourished people increased from 848 million to 923 million largely because of the price crisis during this period (FAO, 2008). The 2007-2008 food crisis accompanied with unusual upsurge in food prices caused between 75 and 130 million additional people to suffer malnutrition (Heady, 2011). The causes of price surges are many but they relate to drivers of supply and demand in relation to food stocks, bio-fuel production and export restrictions among other factors (Wright, 2011; Von Braun and Ahmed, 2008). For example, a study by Von Braun and Ahmed (2008) found that bio-fuel production had a 3% to 30% contribution to the 2008 food price hike. Export restrictions, trade barriers and market distortions also have impacts on food prices. In an effort to stabilize domestic prices, countries impose export bans, exports restrictions and export taxes on food products and these results in the increase in prices globally (Hajkowicz et al., 2012). Households who spend most of their income on food are vulnerable to price increases, for example, household expenditure on food as a percentage of total expenditure in Kenya is about 74.8% which means that even a slight increase in food price has negative impact on household food accessibility (Smith and Subandoro, 2007).

Income growth is another factor influencing food insecurity especially in developing countries. This is because income growth leads to changes in patterns of food consumption from traditional staples to proteins and fruits (Chen, 2007). Therefore, global consumption trends are characterized not only by a growing demand for more food, but also for different types of food such as meat. This leads to a disproportionate increase in demand for grain and protein feed needed to produce it (Leibtag, 2008). The expansion of the middle class and economic growth in developing countries have also increased global energy demand leading to rising oil prices, which have an impact in food production (Dorèlien, 2008). Rising fuel prices have increased the

cost of fertilizers, fuel and pesticides used in agriculture and this has caused the prices of agricultural products to increase, and in certain areas, caused output to decrease (Ibid). Increase in oil prices has also increased the demand and production of bio-fuels as substitutes for oil and the increased demand for and production of corn which is converted to ethanol has diverted crop lands away from food production and contributed directly to the rising prices of corn and other staples (Trostle, 2008).

Urbanization is another factor that impacts food security. Urbanization is often associated with decreases in food supply due to loss of agricultural land and dietary diversification (Dorèlien, 2008). According to Chen (2007), about 5.1% of China's total arable land was lost to industrial urban purposes between 1996 and 2003. Growing populations in urban areas also compete with the agricultural sector for scarce water resources resulting in less water for agriculture and that inhibits the abilities of farmers to increase food production (Mbonile, 2007). The world is becoming increasingly urban and it is estimated that urban population will reach 4.9 billion by 2030 while the rural population is expected to decrease by 28 million people (Martin *et al.*, 2007). This huge urban (non-agricultural) population relies on purchased food and is susceptible to increases in food prices.

Food insecurity and HIV/AIDs are interrelated in a vicious cycle that heightens the vulnerability to, and worsens the severity of each condition (WHO, 2003). HIV/AIDs primarily affect the productive generation and the sickness and morbidity caused by the disease diminishes individual ability to remain economically productive and therefore, provide food for the family (Fox, 2012). In East Africa more than 5% of the working-age population is affected and this reduces the human labour engaged in subsistence agriculture resulting in less land being farmed, reduced yields and less intensive crops being grown (Dorèlien, 2008). It is estimated that food production declines by 60% when a household member becomes infected with HIV/AIDs (Fox, 2012). A study in Kenya by Hunter (2008) found that the death of an adult female household member results in fewer grain crops grown while the death of an adult male resulted in decreased production of cash crops such as sugar and coffee. Since subsistence agriculture relies heavily on women's labour, HIV/AIDS related illnesses and deaths therefore, have a huge impact on household food security.

Given the global challenges in food security, food production will of necessity have to increase by 70% to feed a population of nine billion people by 2050, this means that an additional 1 billion Metric Tones (MT) of cereals and 200MT of meat will be needed annually to meet the demand (FAO, 2009). Sub-Saharan Africa has three options for meeting the rising food demand; raise overseas food imports, raise domestic food production or increase both (Seiler, 2013). Already the Africa continent imports about 30% of all the cereals consumed, therefore, ensuring food supply through increased imports is not an easy option (FAO, 2013). A food secure future will require that farmers produce more food on less land, with less water, increased fertilizer and pesticides. Climate smart agriculture must also enhance and secure livelihoods of rural farmers through intensification accompanied by protection of the environment (Uploff, 2012). There is need to integrate food security and sustainable agriculture into global and national policies, significantly raise the level of global investment in sustainable agriculture and reduce loss and wastage in food systems targeting infrastructure, farming practices, distribution and household habits (Ibid).

#### 2.3.1 Food Security in Kenya

In the 1960s, Kenya could feed its population at more than 10% above the WHO requirements assuming that basic foods contributed 75% of the dietary energy (Dietz, 2014). In the 1970s, the country's food situation started deteriorating and after the events of 1979 to 1980 when Kenya suffered a nationwide food shortage, the government made a first attempt to directly address the country's food security situation. The Sessional Paper No. 4 of 1981 (GoK, 1981) on National Food Policy outlined various programmes and policy measures deemed necessary to enable the country maintain a broad-based self-sufficiency in food stuffs without utilizing foreign exchange for food imports. The document proposed strategies for achieving food security for every part of the country so as to ensure that every member of the population had a nutritionally adequate diet. Despite these efforts, food shortages have been experienced in country whenever there is drought, a situation that is becoming more common than before due to global warming.

Food self-sufficiency has been elusive and the National Food Balance Sheets for the period 2000 to 2005 based on a Self-Sufficiency Ratio (expressed as domestic production in relation to domestic utilization calculated for individual commodities) indicated that the country

was not self-sufficient in cereals (CBS, 2006). This situation has since not improved. Maize is the main staple food crop for over 90% of the population in Kenya and also a key component of feedstuff for livestock, therefore, when production falls, the impact is felt nationally and the commodity has to be imported to prevent mass starvation (Nyoro, 2002). Kenya's food situation is also complicated by the fact that the country has a high rate of population growth (2.8% p.a.) which puts enormous pressure on the economy and food availability (CBS, 2006). According to reports (IFPRI, 2012; WFP, 2009), production of the basic food crops such as maize, wheat and rice have not kept pace with food demand and by 2008 about 10 million people in Kenya were food insecure.

The International Food Policy Research Institute (IFPRI) which publishes annual reports on global hunger (the Global Hunger Index) that show the share of undernourished population in countries ranked Kenya 50 out of 81 countries in the year 2011 (IFPRI, 2011) and the following year (2012) the situation in the country had deteriorated leading to the country being downgraded to position 54. This clearly indicates that hunger in Kenya is a serious problem and the country does not meet the requirements of reducing malnutrition as part of the first UN Millennium Development Goal.

Poverty is a key factor influencing food security. The current state of the economy is such that slightly over 50% of the people in Kenya live below the poverty line (Glopolis, 2013). Resources are limited because about 95% of small scale farmers work on less than 4 hectares of land. This is because most of the land (84%) is classified as arid and semi-arid most of which has little potential for agriculture because of dependency on rain water (Landesa, 2011). Land is the main asset in agricultural production. Thus, limited availability of productive land is a major constraint to agricultural and food production. Agriculture is the mainstay of Kenya's economy contributing 26% to Gross Domestic Product (GDP) directly and 25% indirectly. It also accounts for 65% of the exports and provides the means of a livelihood for the majority of rural people (GoK, 2010). Therefore, a declining agricultural sector has serious implications to food security, poverty reduction and general performance of the economy.

In recognition of the state of food and agricultural development, the government of Kenya has set the following targets; reduction of number of people living below poverty to less than 25%, reduction of food insecurity by 30% and to increase the contribution of agriculture to

GDP by more than 80 billion shillings per annum as set out in vision 2030 (GoK, 2010). Land provides the base for all these activities and agricultural growth and development depends not only on improved agricultural technologies but also on review and formulation of appropriate land use policies (Guto, 2012). Policies should influence the manner in which farmers use land to ensure efficient and sustainable exploitation of land resource. This study hopes to provide indepth information on agricultural land use as a base for such policies.

## 2.4 Agricultural Land Use and Household Food Security

The manner in which agricultural land is apportioned to different activities by farm households depend on many factors some of which relate to the physical environment, requirements of the agricultural industry and the prevailing socio-economic conditions (Perz, 2001). According to Dixon *et al.* (2001), land use patterns exhibit spatial dynamics and this is because households are diverse in terms of resources and also because they operate within heterogeneous bio-physical environment. This view is supported by Lambine *et al.* (2003) who argue that the spatial and temporal patterns in land use are an aggregation of land use and management decisions at micro-scale (by households) in response to policy and institutional environment overtures. It is therefore clear that the household's internal demands for survival and subsistence in the context of prevailing socio-economic and political environments determine choice of land use (Walker *et al.*, 2002).

Browder *et al.* (2004), argue that the factors that influence households' decisions on agricultural land use include quality of soil, farm size, level of education of the household head, farming experience, land tenure, distance to the market, farm age, off-farm income, access to credit and technical knowledge among others. A study in Amazon by Pichon (1997) found that apart from soil fertility, topographical location of farm land and duration of settlement, household resource endowments significantly influence land use decisions. Perz (2001) further argues that in addition to household demographic characteristics like education and family labour and consumer units (household size), belonging to groups also has a significant effect on land use decisions.

An effective management of available resources through prudent resource allocation pattern enables a farming household to get as much income as possible from its production and consequently improves its economic access to food (Mohamed and Omotesho, 2014). For

example, in Uganda improved nutrition was associated with a reduction of land allocated to maize and a 600 percent increase in the proportion of land allocated to legumes (McIntyre *et al.*, 2001). Similarly, food security could be achieved in a barley-based system of Ethiopia by reducing the land allotted to barley by 50% and extension of land allocated to other crops (Amede *et al.*, 2004).

Decision-making in agriculture is complex, and in particular those decisions related to utilization of household farms in order to meet food and non-food needs. How a farmer apportions his or her land among different activities depends on a farmer's aspirations, needs, knowledge and the socio-economic environment in which he or she operates (IIbery, 1978). However, optimization modeling can be used to identify alternative production options to achieve household food security and nutrition security by changing crop combinations. In the case where households want to attain food security and also satisfy financial needs, the optimization model which was found ideal in the Ethiopian highlands was one where cash crops (coffee), potatoe and cereals were allocated land in the ratio of 30%, 15% and 8% (Amede *et al.*, 2004). The need for food ranks first among smallholders in the study area as indicated by the fact that they allocate most of their land for its production (GoK, 2013).

## 2.5 Food Security, Agricultural Land Use and Socio-economic Characteristics

According to Dauda (2010), the attempt to determine the link between socio-economic status and household food security has received increased attention over the past few decades. Socio-economic status may be defined as components of economic and social status that distinguish and characterize people and are significant indicators of food security (Ibid). Various studies in Kenya (Walingo *et al.*, 2009; Volege, 2005) have successfully linked household food security and socio-economic factors. Some of these factors include; level of education of household heads, poverty, crop yields, household size, literacy level, amount of land owned, food production level and household income among others.

Household size is a significant factor in agriculture and food security. It influences farm activities as it determines availability of labour for farm production, the total area cultivated, amount of food retained for subsistence consumption and the marketed surplus (Aidoo *et al.*, 2013). Several studies indicate that household size has significant but inverse association with household food security which suggests that as household size increases, the food security status

deteriorates (Sekhampu, 2013; Adebayo, 2012; Omonona and Agoi, 2007; Kaloi *et al.*, 2005). A study by Oluok (2006) on food security and poverty among small scale farmers in Nyando district, Kenya also showed that household size is positively and significantly associated with food security and but in contrast, the larger the size the better the households' food situation. In this case, household size is seen as a source of more labour for farm activities rather than a burden. Other studies found no significant relationship between household size and food security, Feleke *et al.* (2005), for example, found no significant association between household size and household food security in Southern Ethiopia.

Household composition is also seen as an important factor which may determine household food security. A study by Kuwornu *et al.* (2013) in the Central Region of Ghana found that households' dependency ratio is significantly related to household food security and that the relationship is inverse but Nyangweso *et al.* (2007) found that it is not household size *per se* but rather the number of adults in the household that is significantly associated with household food security.

Further, education has been found to have a direct link to household food security. Education enables people to diversify assets and activities, increase productivity and income and these elements ensure food security in the long run (Olayemi, 2012). Studies show that the educational level of the household head is significantly and positively related to household food situation (Asogwa and Umeh, 2012; Kaloi *et al.*, 2005). The significance of education is related to the fact that literate farmers are able to reap the fruits of modern agriculture through extension, information and farmer-to-farmer sharing of ideas which is essential in achieving food security (Amaza *et al.*, 2009). This is also supported by Opara (2010) who found a positive correlation between educational qualification and agricultural information in Imo State, Nigeria. Moreover, Burchi and De Muro (2007) also found that an increase of access to primary education by 100% causes a substantial decline of 20% - 24% in food insecurity among households. Omonona and Agoi (2007) also found that food insecurity incidence decreases with increase in the level of education in Lagos State, Nigeria.

Gender differences are another set of determinants of food security not only in terms of differences in access to food of individual men and women, but also because of gender-differentiated roles and responsibilities in food production (Dodson *et al.*, 2012). Women are

traditionally restricted from exercising direct control over productive assets such as land, human and social capital, and often need permission of their husbands or male relatives to do so (Chibende, 2011). This has an impact on their household food situations. Babatunde *et al.* (2008) conducted a gender based analysis of vulnerability of food security in Nigeria, and found that female-based households were more vulnerable to food insecurity than male headed households. This was probably because men owned the said assets while their female counterparts traditionally had no access to them. Chibende (2011) also found that male headed households are more likely to cultivate larger pieces of land in a shorter period and engage in more income earning ventures compared to female headed households. However, Mallick and Rafi (2010), found no significant difference in food security between male headed and female headed households among the indigenous ethnic groups in Bangladesh.

Farm size has been found to be closely linked to food security and this is because large farms enable households to expand areas devoted to food production and to diversify their agricultural activities, leading to higher incomes and food security (Van Der Veen and Tagel, 2011). A study by Volege (2005) in Vihiga district, Kenya found that the amount of land owned by households was a direct indicator of household food security. This was also confirmed by Aidoo *et al.* (2013) who found farm size to be positively and significantly related to the probability of households being food secure. Other studies (Bogale and Shimelis, 2009; Feleke *et al.*, 2005), also confirm that farm size is significantly associated with household food security but whilst confirming the relationship, Sikwela (2008), however shows that the relationship is negative.

Food insecurity at the household level is also a result of lack of adequate income with which to purchase food. Households with diversified sources of income (e.g. land and livestock) or those with higher income levels are likely to be more food secure than those with low income because such households have the capability to withstand shocks in prices that cause food shortages (Loopstra *et al.*, 2013). A study by Arene and Anyaeji (2010) in Enugu State, Nigeria found that a significant relationship exists between household income and household food security, and that the higher the income the greater the chances of households being food secure. Boakaye-Achampong (2012) in his study on food security status in Ghana also observed that farm income and off-farm income are significant factors influencing household food security.

Other studies (Khan and Gill, 2009; Mukoya-Wangia's 1999), also confirm that keeping of livestock and high income levels, have a significant influence on household food security. However, a study by Rahim *et al.* (2011) in Qaresso region of Iran, found that it is not just household income, but rather the per capita income that has a significant inverse correlation with household food security. Asogwa and Umeh, (2012), however, argue that generation of farm income is a measure of the extent of agricultural commercialization and this can affect food security negatively. This arises from the possibility of some households being forced to sell more food when in need of income and in the event this exposes such households to food insecurity.

Apart from the socio-economic factors discussed above, the type of technology applied in agricultural production also determines household food security. According to Nyoro (2002), the secret of increasing maize productivity in Kenya lies in increasing the quantities and quality of yield enhancing inputs such as fertilizer. Yield gains are important in view of the fact that opportunities to raise farm production by bringing additional land into cultivation have significantly diminished with population increases.

A study on food security and agricultural development in Kisii district also found that a significant correlation exists between food security and levels of farm technology among other factors of production (Nyandika, 1994). This is supported by Feleke, *et al.* (2005), who showed that adoption of technologies such as high yielding seed varieties and application of fertilizers improved food security among rural households in Ethiopia.

The foregoing review of literature clearly indicates that the way a farm household allocates its farm to different land uses together with its socio-economic characteristics determine its material well-being and food security. These factors are expected to have significant implications on agricultural land use and household food security in the study area.

## 2.6 Theoretical Explanations about Food Security, Food Insecurity and Famines

Food insecurity is a complex issue that requires multiple theories and integrative methods to fully explain it (Scanlan, 2003). According to Lang (2011) a wide range of criteria can be used to judge the efficacy of food systems including; social, cultural, environmental and economic considerations. However, Maxwell and Smith (1992) argue that household issues are central and that food security must be treated as a multi-objective phenomenon best explained by the food insecure people themselves, and that explanations involve adaptability, flexibility,

diversification, resilience and perceptions. The following are theories and explanations of causes of food security, food insecurity and famines based on demographic, environmental, entitlement and sustainable livelihood approaches.

## 2.6.1 Demographic Theories

Demographic theories which explain food security are based on the relationship between population growth and the ecological capacity to provide sufficient food. The level of land productivity in relation to the population on land may determine whether a famine will occur or not especially if the carrying capacity is too low to produce adequate food for the population (Misselhorn, 2006).

Demographic theories had their origin in Thomas Malthus's "Essay on the Principle of Population" written in 1798 (Malthus, 1798). Malthus postulated that the populations of the world would increase in geometric proportions (2, 4, 8, 16, 32 and so on) while the food resources available for them would increase only in arithmetic proportions (2, 4, 6, 8, 10 and so on). As a result, food production would not be able to keep pace with population growth and eventually famine would act as a population control. Critics believe that the basis of Malthusian theory has been discredited in the years since the publication of his works due to major advances in agricultural techniques and modern reductions in human fertility (Lomborg 2002; Devereux, 2000). Moreover, it is argued that Malthus made an error in equating demand for food with food supplies and that he did not foresee a situation where agricultural productivity could be increased through technical revolutions in agriculture, transport and communication as happened in the 19<sup>th</sup> Century (Devereux, 2000),. These developments made it possible for food movements between the surplus and deficit regions. Devereux (2001) further argues that population growth is a slow process while food crisis often occur due to a certain shock in a vulnerable food system.

However, the oil crisis of the 1970s, and the famine in parts of the Sahel region of Africa in the 1990s, all seemed to vindicate Malthus as it appeared that the human numbers had outstripped the ability to sustain them, not only with regards to food but also in regard to resources such as oil, land and water (Wolfgram, 2005). A number of modern scholars believe that the basic concept of population growth outstripping resources is still valid if no action is taken to curb population growth (Luiggi, 2010).

Since 1970s, other demographic factors contributing to famine and food insecurity have been proposed by neo-Malthusian scholars who argue that the world has a limited carrying capacity which will reach a plateau (Grimm, 2012). According to Ehrlich (1968) and Hardin (1968), rapid population growth will have negative impact on sustainability of resources, food, energy, land and the environment. But contrary to neo-Malthusian theory, Simon (1996) argues that the earth carrying capacity is essentially limitless and hence a growing population is a positive factor as it provides more labour and creation of new solutions. Other scientists also argue that there is no such a thing as a human carrying capacity and therefore, there is no environmental reason for people to go hungry now and in future (Ellis, 2013). Nevertheless, neo-Malthusians maintain that high population growth rates lead to high dependency ratios among households. According to Devereux (2001), this is a valid concern because a high number of consumers in a household leads to among other things, sub-division of land into uneconomical fragments not adequate to produce enough food to feed the family. Devereux (2001) also emphasizes that increasing demand for food can affect food security negatively in low income food deficit countries in Africa because of the rising food prices and inadequate food aid.

Environmental and development thinking in many areas still leans towards neo-Malthusianism and while the resource availability was a major concern in this line of thinking, other scholars emphasized the social and economic consequences of ecological degradation. Both Vogt (1948b) and Osborn (1948) argued that there is a close link between the enormous problem of population growth and the worlds' limited food supply, and warned that technology was not enough; resources were not unlimited and the pressure of population itself must be reduced.

According to the foregone arguments, food production is seen as the main determinant of food insecurity. Misselhorn (2006) argues that this kind of thinking can lead to an over evaluation of large scale food production and may lead to policy prescriptions which focus on restricting population growth. He further argues that neo-Malthusianism places the responsibility of food insecurity on the poor and the vulnerable, without considering other underlying causes like political dynamics. While agreeing with Misselhorn's views, Devereux (2001) points out that the emphasis on link between food production and food security has resulted in a misdiagnosis of the real problem and argues that sustainable solutions to the population crisis

should address the problem and not the symptom and that policies should set the means of reducing poverty rather than keeping the numbers of people low. Nichols (1999) maintains that neo-Malthusianism overlooks significant underlying reasons of poverty, food insecurity and environmental degradation.

Boserup (1965) has also challenged the neo-Malthusian prediction that the world will face severe constraints in its efforts to feed whole populations because the world has limited carrying capacity while populations are growing exponentially and indefinitely. Her case studies drawn from South East Asia showed that population growth and agricultural intensification could be accompanied by an improvement in community resources (Ibid). She argued that rising population densities allow for more productive agriculture through technological adoption and greater specialization because land has to be worked more intensively to generate food to satisfy the growing demand triggered by rising population (Boserup, 1983). This situation, however, does not seem to play out in Africa where population continues to grow amidst declining food production due to declining yields. According to Grigg (1980), intensification of agriculture is a gradual change towards patterns of land use which makes it possible for an area to be cropped more frequently than before to enhance productivity. Although subdivision of land does not necessarily lead to a fall in output, it is true that land sub-division could reduce farm size to levels where it is not possible to provide adequate subsistence from the cropped area (Omosa, 1998). Although, the Green Revolution of the 1960s and 1970s is credited with stimulating cereal productivity and ensuring food security almost globally, current analysis of yield increases of eight basic cereals (barley, corn, millet, oat, rice, rye, sorghum and wheat) in comparison to increase in human population indicates that the impact of the revolution has come to an end (Ziska et al., 2012).

## 2.6.2 Environmental Explanations

Agriculture is highly dependent on climate patterns and variations. Solar radiation, temperature and precipitation are the main drivers of crop growth and determine to a large extent whether the biosphere is able to produce enough food for human population and domesticated animals. Extreme temperatures and precipitation can prevent crops from growing and floods and droughts can harm crops and reduce yields. These conditions are as a result of raising earth temperature due to increasing greenhouse gas emissions (IPCC, 2007). The resultant climate

change directly affects agriculture by influencing distribution of crop pests and livestock diseases, reducing water supplies and enhancing severity of soil erosion which will have cumulative effects on household food security status (McCarthy *et al.*, 2001). Although arguments have been advanced that some crops in some regions of the world will benefit from climate change, the overall impacts of climate change on agriculture are expected to be negative (IFPRI, 2009).

A combination of population pressure, deforestation and over grazing together with a decline of rainfall in the semi-arid areas of Africa and Asia is expected to cause a decline in food production (Devereux, 2001). Studies indicate that in sub-Saharan Africa, climate change will cause a reduction of 22% in maize yields, 17% in millet and 18% yield losses for groundnuts (Shlenker and Lobell, 2009). These situations are already being felt in the Sahel region in West Africa and the Horn of Africa which is regarded as one of the most food insecure regions of the world with almost 50% of its population undernourished (FAO, 2000). The adaptive capacity of the agricultural sector to climate change in Kenya is low mainly due to limited economic resources for investment, low levels of economic development, frequent droughts and floods, endemic crop and livestock diseases, high level of post-harvest losses and general poverty among majority of smallholder producers (Odera *et al.*, 2013).

Proponents of climatic and environmental theories have the same argument like Malthus about the cause of famine and food insecurity. Thus, they do not foresee a situation where the populations faced with these processes are able to act in response to long-term threats to their livelihoods (Misselhorn, 2006). Organizations such as Oxfam are at the forefront in urging nations faced with extreme weather changes (especially those who depend on rainfed agriculture) to use adaptation strategies which will raise capacity of vulnerable people to thrive in spite of changes in climate affecting their livelihoods (Oxfam, 2011).

#### 2.6.3 The Entitlement Approach

One of the key concepts of food security is food accessibility. The focus on access is a phenomenon of the 1980s largely resulting from the work of Sen (1981) on food entitlements. The basic question posed by Sen's entitlement approach was why there are famines while food supply is still adequate. This was contrary to Malthus's argument that food insecurity and

famines are caused by lack of food supply (Malthus, 1798). Sen's contention was that famines occur due to lack of access to food which is determined by entitlement and endowments.

According to Sen (1981) there are four legal ways of acquiring food. The first is through trade-based entitlement, which means the ability for people to sell or buy something for food. This refers to the right to own what one acquires through exchange of commodities, for example, selling of crops and livestock. The second way of accessing food is through production-based entitlement. This refers to the ability to grow and produce food using one's resources. The third is through labour-based entitlement meaning the right and ability to sell one's skills or labour power in order to purchase or produce food. Inheritance and transfer based entitlement is the fourth and includes food transfer or the right to own what is rightly given by others. This includes remittances from household members engaged in off-farm jobs and also food aid (Grimm, 2012).

The entitlement approach also includes the idea of "endowments" which refers to what one owns. Most people own assets like livestock and household goods which can be sold when need arises to purchase food. The set of commodities that can be acquired through sale or barter is defined by "exchange entitlement mapping". Sen argues that an entitlement failure can occur or people can face famine because they do not have access to food due to food production failure as a result of natural disaster; if they cannot buy or sell anything (market failures); or because of high food price in the market. The food producers may also opt to sell food to other markets in different geographical areas with higher price than that of the local market. Starvation can also happen when there is a fall of nominal and real wages in the labour market and when there is no food to give people who have famine problems (Devereux, 2000). Therefore, people may face food shortages due to rising food prices, falling wages and decreasing price of cash crops which lead to declining terms of trade.

Sen also introduced the concept of "derived destitution" in which he argues that it is not only farmers that are vulnerable to production shocks, but all those who depend on their incomes, for example, agricultural labourers and providers of rural services. This is because when incomes from farming decline farmers are forced to sell assets to buy food and have therefore, less money to spend on non-essentials and assets.

Critics argue that the entitlement approach denies the importance of food shortages in explaining famines because of the insistence that famines can occur without food shortages. But, Devereux (2001) explains that certain famines like those that occur in Africa are more associated with war or conflicts which affect food production rather than droughts. Sen recognizes four limitations of the entitlement approach. In the first instance, there can be ambiguities in the specification of entitlements and secondly, entitlement relationships concentrate on rights within a legal structure in a society but some transfers are illegal, for example, stealing or forceful acquisition which is excluded. Entitlement approach also assumes that people facing food insecurity automatically convert their goods or assets into entitlements and do not acknowledge the possibility of adoption of coping mechanisms which may include voluntary starvation. Finally, Sen acknowledges that peoples' actual food consumption may fall below their entitlements for reasons such as ignorance or apathy (Sen, 1981). Despite these limitations, the entitlement approach provides a way of separating issues related to food availability and access and linking them to specific groups of people, thereby, enabling the development of vulnerability profiles for different livelihood systems (Grimm, 2012).

# 2.6.4 Sustainable Livelihood Approach

The theories discussed above show that food insecurity and famine are a result of complex interactions between different factors. The Livelihood Approach acknowledges this diversity and addresses the problem of food insecurity and poverty in a more holistic manner (Grimm, 2012). In this way, it provides a better understanding of peoples' livelihoods based on their assets, strategies and goals (Ibid). Chambers and Conway (1992) define livelihood as comprising capabilities, assets and activities required for a means of living. A livelihood is sustainable if it can cope with and recover from stress and shocks and maintain or enhance capabilities and assets and provide sustainable opportunities for the next generation.

The assets that are recognized within the Sustainable Livelihood Approach are categorized into five groups (DFID, 1999) namely; (1) the Natural Capital which refers to natural resources like land, water, wild life and biodiversity; (2) the Physical Capital which is the basic infrastructure like equipment of production, transport, communications and energy; (3) the Human Capital which includes health, knowledge skills, labour and information; (4) the Social Capital and finally, (5) which relates to membership of groups, networks, access to wider

institutions and finally, Financial Capital which refers to financial resources available from savings, pensions and credit (Figure 2.1).

According to Swift and Hamilton (2001), Sustainable Livelihood Approach explains household food insecurity as a result of shocks or stress that can be brought about by economic, social and natural factors. Livelihoods are defined in terms of the activities people engage in and the entitlements and assets they own and livelihood strategies. Interventions are interrelated with government policies, investments and the technology available. Food security, therefore, can be considered an important element of a sustained livelihood and the reasons why some households are food insecure are rooted in the ways livelihood systems have changed and adapted or failed to adapt to different changes.

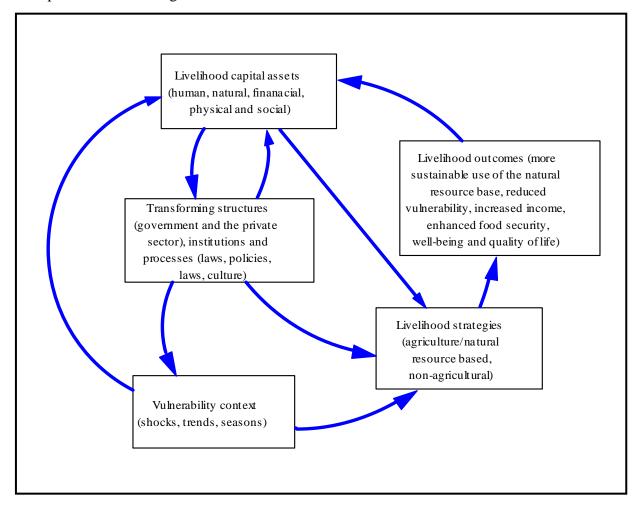


Figure 2.1: Sustainable Livelihood Framework

Source: Department for International Development (DFID), 1999

The preceding sections have presented theories that explain causes of food insecurity and famine. It is clear that no one theory can exhaustively explain causes of food insecurity at household, national or regional levels. This is because food security is multi-dimensional and the result of the interplay of factors such as natural, social, cultural and political systems at different geographic scales. All the theories and approaches that have been reviewed have some applicability to the current study as they are capable of explaining aspects of food security at the household level. However, Sen's (1981) entitlement approach was selected as the theoretical base of this study because it allows food security assessment on specific groups of people who may be defined geographically, demographically or occupationally through their various entitlements and endowments. This study focused on production and trade-based entitlements of small scale farm households (in Kisii Central sub-County) and their impact on food security. These entitlements are related to how households utilize their farms.

#### 2.7 Theoretical Framework

The issue of food security continues to attract attention globally. Discussions seem to centre on two points namely; a concern for improvements in supply so as to satisfy demand, and the need for creation of income generating opportunities (entitlements) to enable those in need to access the available food. Therefore, the problem of food insecurity is not just about food production alone but also about the general problem of poverty and unequal distribution of purchasing power among households.

This study was conceptualized using part of Sen's entitlement model which provides explanations on how households gain access to food. According to Sen (1981), food security flows from possessions which come from endowments which, in turn constitutes a person's entitlements. Entitlements fall into four categories; production-based entitlements which are ownership through commodity exchange; labour entitlement which simply means the sale of one's labour; trade-based entitlement which means ability to sale or buy something for food and finally the inheritance and transfer entitlement which imply the right to own what is given by others. This approach, to a large extent, explains how food security is realized, and why some groups starve while others do not. It also explains what conditions enable some people to be food secure and others food insecure.

It should, however, be noted that endowments themselves do not bring about adequate food but they provide the potential to obtain food. Whether this potential translates into adequate food or not depends on what Sen (1981) calls 'exchange mappings'. This refers to the network of relations that govern how much food one is able to attain through cultivation or through purchasing, and hence an exchange with others. A person's exchange entitlement is influenced by employment opportunities, returns to non-labour assets relative to the cost of food, own production, the cost of purchasing resources, the value of what they can sell and the other obligations that they must meet. Therefore, the ability to acquire enough food depends on one's endowment and subsequently on the exchange mapping. For instance, farmers who own land, labour and other productive resources could be faced with a number of possibilities; grow their own food or purchase it using money earned from selling their labour or growing of cash crops that could be marketed for cash or they could benefit from cash or food transfer.

Sen's model of entitlements therefore provides a useful theoretical framework that is appropriate to this study because it provides explanations as to the type of entitlements households rely on to achieve food security. The study mainly focused on production-based and trade-based entitlements although labour-based and inheritance / transfer entitlements were also used to explain household food security situation. Therefore, based on Sen's model, this study hopes to provide information about the choices households make in utilization of their land to gain entitlements and how these choices impact on their household food security.

### 2.8 Gaps in Literature

The literature reviewed indicates that household food insecurity is recognized as one of the most significant challenges facing the world today. Literature reveals that causes of food insecurity are complex and multifaceted and relate to household characteristics which vary from place to place. Climate change and global warming are becoming important causes of food insecurity and threaten livelihoods of millions of people who depend on agriculture especially in the developing world. The literature reviewed also show that problems of food insecurity in sub-Saharan Africa are directly related to the increasing food demand as a result of rapid population growth and inadequate food production. There are indications that the situation will continue to deteriorate because of the high levels of poverty and declining arable land. Available land is overly sub-divided into small uneconomic units resulting in fragmented production systems and

low productivity and already about 80% of the farms in Africa are less than 2 hectares. Literature also shows that agricultural land use is influenced by households' internal demands for survival and subsistence in the context of prevailing socio-economic and political environment. Decisions on land use are often based on quality of soil, farm size, labour, level of education of the household head, land tenure, farming experience and other demographic characteristics.

However, no study has been found that addresses the impact of agricultural land use on household food security in the study area. By focusing on households, their characteristics, farm allocation and food security status, the study builds not only on knowledge of issues of food security, but also adds value on aspects such as inter-relationships among factors that determine agricultural land use and the general agricultural character of the study area.

Assessment of households' food security situation was based on households' own perception of food security throughout the year. The use of such subjective measures is growing in food security studies and this work presents one such application which provides a contribution to literature.

# 2.9 Conceptual Framework

This study conceptualizes that the manner in which households in the study area utilize their farms determines their entitlements which, in turn, influences their access to food. In line with Sen's 1981 entitlement model, household food security is viewed as a function of entitlement (agricultural land resource) transformed through production or trade into food or commodities which can be exchanged for food (Sen, 1981).

The food security status of a household depends on the type of the agricultural land use adopted. Cash crop production avails income that may be used in the purchase of food while food crop production provides household with their own food. Fruits and vegetables may be sold to earn some income which may also be utilized to access food. Pasture and napier grass land use may be seen as a proxy to livestock and livestock products such as milk may be consumed by the household or sold to earn some income. Cultivation of napier grass is an important activity in the study area and is utilized as a fodder crop. Households without livestock sell it to earn some income with which to buy food or other necessities.

Despite the assertion that agricultural land use influences household food security, the status of food security in households cannot be explained by a single variable. This is particularly

true considering that in the empirical world, variables are interlinked in a complex manner. Agricultural land use is determined by the physical, socio-economic, demographic and political factors which impose certain broad limits within which households can access food. All these factors are capable of having independent and interactive effects on household food security. For example, climate, topography and soils determine the kind of agriculture that can be practiced in an area. Characteristics of household heads such as gender and level of education can determine their response to extension services and adoption of new technologies which can directly influence agricultural productivity and household food security. Agricultural land use on the other hand may be influenced by considerations such as amount of land resource available (farm size) household income and household size amongst others. The political environment, on the other hand, initiates policies that have an impact on agricultural land use and productivity. Such policies influence agricultural research activities, provision of inputs, incentives and extension services. They also impact on food distribution systems through development of infrastructure. All these factors interact in a complex manner which ultimately influences household food security situation (Figure 2.2).

According to Sen's Entitlement model, access to food by households is determined by what they own, produce, trade, inherit or are given. Likewise, access to food by households in the study area is also influenced by ability to grow and produce food based on household resources such as land (production-based entitlements), through purchase using earnings from sale of crops and livestock (trade-based entitlement), the ability to sell own skills in order to purchase or produce food (labour-based entitlement) and access of food through transfer, gifts, remittances or food aid.

Although, it is clear that household food security is a function of many interrelated-variables and that any change in one of them will trigger a chain reaction on the rest including household food security, however, most of these variables were presumed to be constant and the study confined itself to the analysis of the relationships among agricultural land use, household socio-economic characteristics and household food security.

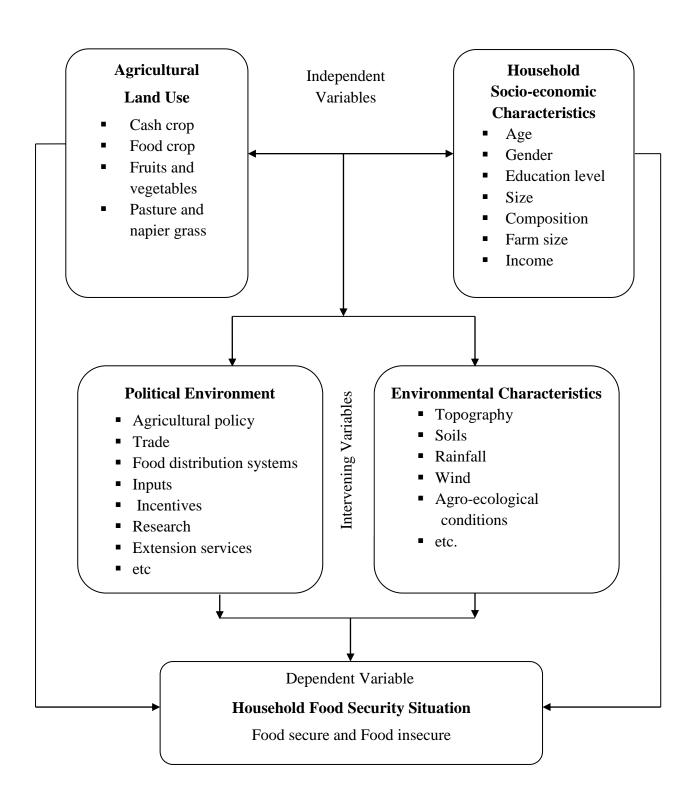


Figure 2.2: The Conceptual Framework of the Study

Source: Derived from Literature Review

# CHAPTER THREE RESEARCH METHODOLOGY

#### 3.1 Introduction

This chapter presents the research methods used in this study. The first section deals with the background to the study area followed by a detailed description of the various methodologies organized in sub-sections.

## 3.2 Study Area

This section presents detailed information of the study area; location, topography and climate, agro-ecological zones, soils and demographic characteristics. Discussion of these details is justified on the grounds that agriculture is the main focus of the study therefore, it is important to understand these factors in so far as they impact on the utilization of the agricultural land resource and food security. The following is a discussion of the characteristics of the study area.

#### 3.2.1 Location

Kisii Central sub-County is located in Kisii County in the former Nyanza province of Kenya. It lies between latitudes 0°30' and 0°58' south, longitudes 34°42' and 35°05' East. The area is bordered by the following; Nyamira County (East), Gucha sub-County to the South West, Masaba to the South East and Rachuonyo and Homa Bay sub-Counties to the North and North West respectively (Fig. 3.1). The sub-County occupies a total area of 361.0 km² and is subdivided into four administrative divisions namely; Keumbu, Kiogoro, Marani and Mosocho (Kisii Central District, 2008).

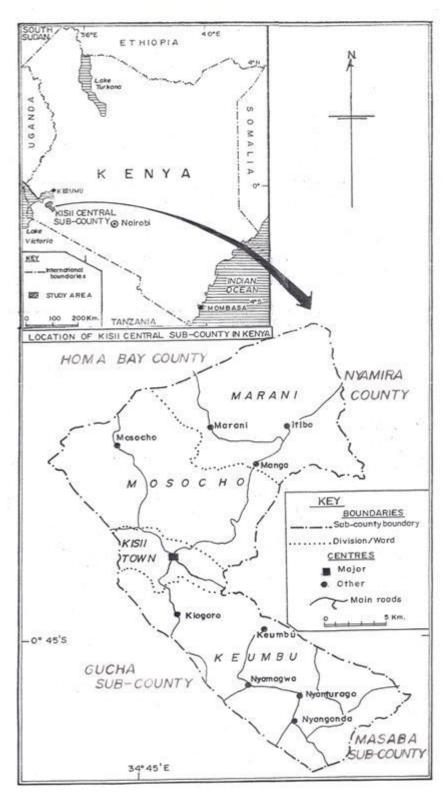


Figure 3.1: Location of the Study Area: Kisii Central sub-County

Source: Kisii Central District, 2008

## 3.2.2 Topography and Climate

Kisii Central sub-County is a highland region characterized by a hilly topography with several ridges and valleys. Topographically, the sub-County may be divided into three zones; the first zone has an average altitude of less than 1500m above sea level and is mainly found in Mosocho division, the second zone consists of all the area lying between 1500m and 1800m above sea level mostly covering the northern part of the sub-County particularly parts of Kiogoro, Mosocho and parts of Marani divisions (Jaetzold et al., 2009). There are few areas whose altitude is above 1800m and these are found in Kiogoro and Keumbu divisions. The topography of the area partly dictates land use, for example, the steep slopes associated with the numerous hills are used mainly for natural pasture while the gentle slopes and valleys are used for crop production. The sub-County has several permanent rivers which flow from east to west into Lake Victoria and the major ones are Kuja and Mogusii (Figure 3.2). The area generally experiences mild temperatures of between 18°C and 21°C. The western part of the area experiences higher temperatures than those normally found in this altitude range but they reach normal altitude temperature in the East (Jaetzold et al., 2009). This variation in temperature dictates to some extent the types of crops grown productively in different parts of the area. The tea crop prefers the cooler temperatures of the Central region while sugarcane and bananas are more suited to the lowlands on the north.

The study area has a highland equatorial climate and one of the wettest in Kenya because it is situated in the centre of the local convergence of the daily lake winds (Lake Victoria) with the easterlies during the generally dry seasons in Kenya (Ibid). Average annual rainfall ranges between 1200mm and 2400mm. Most of the district receives between 1600mm and 2000mm in northern parts of the district (Mosocho and Marani) and also in the southern part of Keumbu division. The central area with higher altitude (Keumbu and southern part of Marani) receives more rain averaging between 2000mm and 2400mm annually (Figure 3.3). The high rainfall amounts has encouraged cultivation of a variety of crops and rearing of dairy animals.

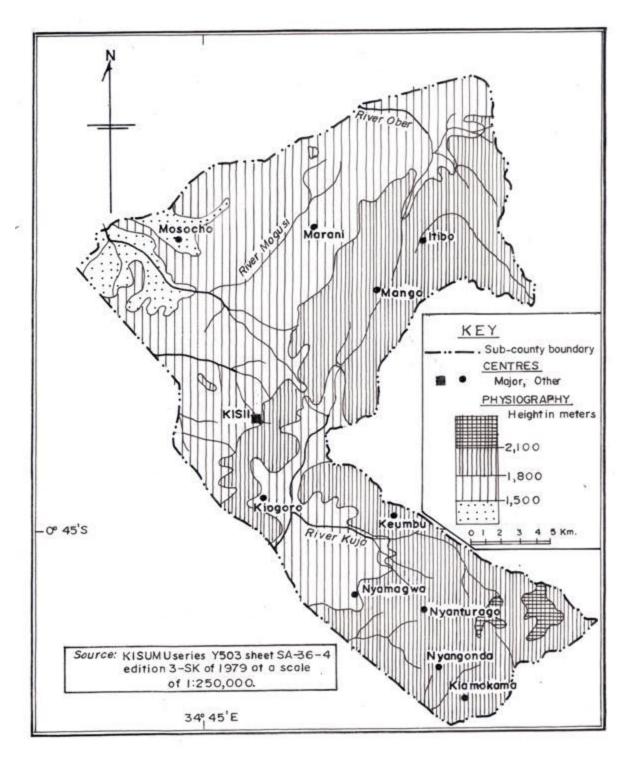


Figure 3.2: Topography: Kisii Central sub-County

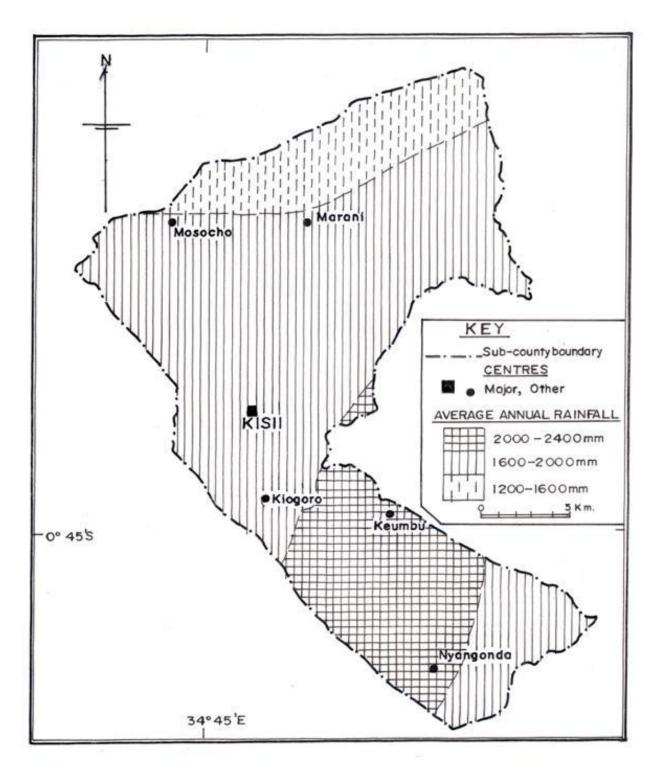


Figure 3.3: Rainfall Patterns: Kisii Central sub-County

Source: Jaetzold et al., 2009

The study area experiences two rainy seasons; long rains are received from February to June while short rains occur between September and November. According to Jaetzold *et al.* (2009) drought is almost improbable because of the high rainfall reliability, the probability of the area south of Kisii Township receiving between 800mm to 900mm of rainfall a year is 66% (10 years out of 15 years) and the amount increases to between 900mm to 1000mm on the northern part for the long rain season. The rainfall in the second season is equally reliable following the same trend as the first season one with the lowest being 400mm in the south but increasing gradually northwards with Keumbu town recording 500mm and the rest of the north registering about 600mm per annum (Jaetzold *et al.*, 2009).

Climate and agriculture (especially rain-fed) are interlinked because without ideal weather conditions agriculture cannot produce surplus supply that is required to maintain livelihoods. Kisii sub-County experiences high and reliable rainfall coupled with moderate temperatures which are suitable for the growing of crops such as tea, coffee, maize, beans and bananas as well as dairy farming. However, studies indicate that agriculture in the tropics suffers a 30% to 50% decrease in productivity relative to temperate-zone agricultural productions due to low fertility of soils, excessive plant respiration, ecological conditions favouring infectious diseases and high evaporation among others (Gallup *et al.*, 1999).

#### 3.2.3 Agro-ecological Zones

Agro-ecological zones are geographical areas exhibiting similar climatic conditions that determine their ability to support rain-fed agriculture. The zones are influenced by latitude, elevation, temperature as well as seasonality, rainfall amount and distribution during the growing period (HarvestChoice, 2010). World agro-ecological zones were established by FAO in 1978 (FAO, 1978) with the objective of guiding international agricultural policy and to give advice to farmers in different locations about yield potentials and risks associated with production of different crops and keeping of animals in various ecological areas. The main agro-ecological zones in the study area are; the Lower Highland (LH) and Upper Midland (UM) with a few of their subzones (Jaetzold *et al.*, 2009). Most of the area is a Coffee-Tea zone (UM<sub>1</sub>), and covers the central part of the study area northwards from Kiogoro to most of Mosocho and Marani area (Figure 3.4).

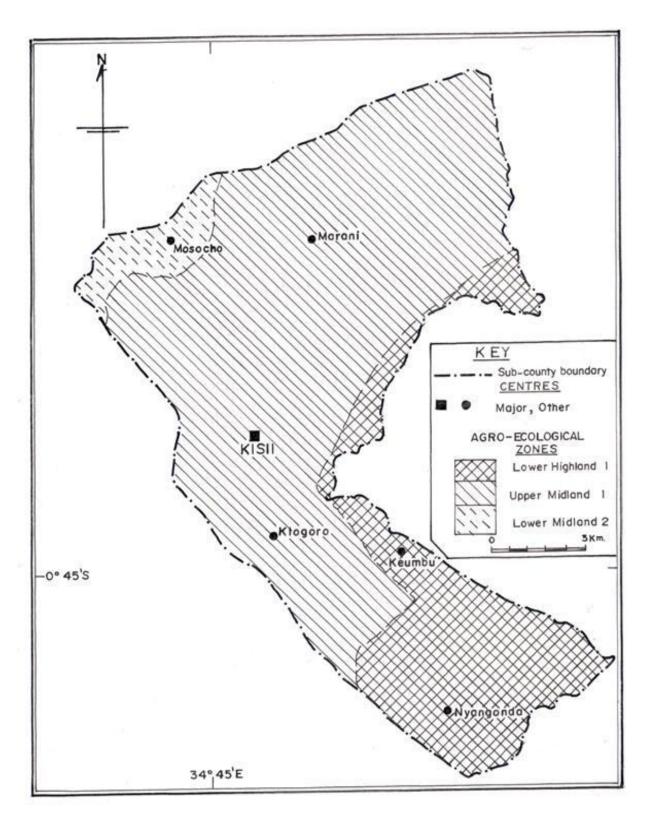


Figure 3.4: Agro-ecological Zones: Kisii Central sub-County

Source: Jaetzold et al., 2009

According to Jaetzold *et al.* (2009), the UM<sub>1</sub> zone generally receives annual rainfall ranging between 1600mm and 2000mm with average temperatures of between 18°C to 21°C. A part from being ideal for coffee and tea, it also has a very good yield potential for maize, potatoes, soya beans for the first season rains. Bananas, avocadoes and pawpaws can be grown throughout the year. Maize and beans may also be grown in the short rains period. The extreme north west of Mosocho has a small area covered by the Lower Midland zone (LM<sub>2</sub>), which is a Marginal Sugarcane zone with average rainfall ranging between 1480mm to 1600mm and average temperatures of between 21°C to 21.6°C. It has a fairly good yield potential for sorghum, sweet potatoes, soya beans, pawpaws and guavas. In addition, the zone has good yield potential for maize and pigeon peas and it is also suitable for Robusta coffee, bananas, sugarcane, cassava and onions (Jaetzold *et al.*, 2009).

Most of Keumbu division is covered by the Lower Highland subzone (LH<sub>1</sub>) which is a Tea – Dairy zone. It receives average rainfall of between 1400mm and 2100mm per annum with mild annual temperatures of between 16°C and 18°C. It has ideal conditions for the growth of tea and keeping of high quality dairy animals. It has very good (> 80% of optimum) yield potential for vegetables and potatoes. The zone also has a good yield potential (60 - 80%) for maize, finger millet and sweet potatoes. The Coffee - Tea zone covers most (75%) of the study area followed by Tea - Dairy zone. Therefore, in terms of agro-ecological conditions, Kisii Central sub-County offers ideal conditions for a variety of farm enterprises that could produce high returns if managed sustainably which in turn could boost household food security.

#### **3.2.4 Soils**

According to Jaetzold *et al.* (2009), most of the study area has upland soils developed on igneous rocks (118u, 199u, 126u and 152u) and are called phaeozems and nitozols. These soils are well drained, extremely deep with humid top soil. They have moderate to high fertility, and hence, suitable for the growth of a variety of crops. Analysis of the soils indicates that most of the area is suitable for agriculture except in some isolated areas where the soils are young and shallow, especially on hilltops. Most areas south of Kisii Township around Kiogoro and Keumbu though initially fertile, these soils have been exhausted and now require soil management like organic manuring and protection against soil erosion (Ibid).

## 3.2.5 Demographic Characteristics

In the 1999 population census, the district rural population was 262,299 people (CBS, 2001). This population was projected to increase at 2.72% per annum to reach 321,025 people by the year 2008 (Kisii Central District, 2008). Administratively the study area is divided into four divisions namely Keumbu, Kiogoro, Marani and Mosocho which were curved from the former larger Kisii Central which included Masaba and Suneka divisions. Table 3.1 provides a summary of administrative area and population characteristics.

Table 3.1: Population Characteristics of Kisii Central sub-County (1999 - 2012)

		1999		200	)8	2010		0 2012	
Division	Area Km <sup>2</sup>	Pop.	Dens.	Pop.	Dens.	Pop.	Dens.	Pop.	Dens.
Keumbu	71	47,934	675	57,388	808	58,547	824	60,936	858
Marani	123.7	89,215	721	106,810	863	108,968	880	113,415	916
Mosocho	87	63,247	960	82,716	1149	123,090	1172	128,114	1220
Kiogoro	61.3	61,903	1010	74,111	1208	75,608	1233	78,694	1283
Township	18	-	-	-	-	-	-	-	-
District	361	262,299	830	321,025	994	366,213	1014	381,159	1056

Source: Kisii Central District, 2008; Kisii Central District, 2009

**Notes:** Pop. = Population Dens. = Density

Marani division which is the largest in terms of area (123.7km²) had a population of 89,215 with a density of 721 persons per square kilometer in 1999 which rose to 113,415 with a density of 916 persons per square kilometer in 2012. Mosocho had a population of 63,247 and a density of 960 persons in the 1999 census and this population rose to 128,114 with a density of 1,220 by the end of 2012 (Kisii Central District, 2009). Kiogoro division on the other hand, had a population of 61,903 and the highest density of 1,010 in 1999 per sq km which was expected to reach 1,283 in 2012 (Table 3.1). Kiogoro and Mosocho divisions are more densely populated and this can be attributed to their proximity to Kisii town. This means that the sub-County experiences substantial population pressure which has implications on agricultural land use and household food security.

Kisii Central sub-County had a total of 73,180 households at the end of 2007 (Kisii Central District, 2008). The distribution of households among the four divisions showed that Marani had the highest number (19,841) in the year 2007 followed by Kiogoro (15,719) and then Mosocho (14,578). Keumbu had the lowest (11,467) number of rural households (Table 3.2). Average household size was 5 people although Mosocho division had the highest (7) number of people living together (Kisii Central District, 2008).

**Table 3.2: Distribution of Households within the Divisions (2007)** 

Division	No. of Households	Household size
Keumbu	11,467	5
Marani	19,841	5
Mosocho	14,578	7
Kiogoro	15,719	5
Township	11,575	4
District	73,180	5

Source: Kisii Central District, 2008

The population of the study area is fairly high and could pose some challenges to food security at the household level. To indicate the kind of land pressure the study area experiences, it is important to show the amount of land available for agriculture per household.

Table 3.3: Available Arable Land per Household in Kisii Central District (2007)

Division	Arable agricultural land (Km²)	Amount of land available (hectares) per household
Keumbu	60	0.4
Marani	101	0.8
Mosocho	70	0.4
Kiogoro	49	0.3
Kisii Central	283	0.5

Source: Kisii Central District, 2008

As shown in Table 3.3, the agricultural land available per household in the study area in 2007 was as follows; Marani division had 0.8 hectares (1.98 acres) which was the highest amount while Kiogoro had 0.3 hectares (0.74 acres) which was the lowest. On average households in the sub-County had access to about 0.5 hectares (1.24 acres) of land and considering that households had an average of five people, it meant that the amount of land available per person was almost negligible (0.1ha). The low farm sizes indicate that intensive agriculture has to be practiced in order to make a living out of the small pieces of land and that the household food security may be precarious.

#### 3.2.6 Food stocks

Household food security mainly depends on food availability through production and/or purchase. To purchase food, households must have the money with which to buy it and also, the food must be accessible through distribution systems. An analysis of food availability in the study area (Table 3.5) shows that food stocks were either kept by farmers, local traders or in the local National Cereals and Produce Board (NCPB) depot. A substantial proportion (about 52%) of food was sold to local traders while the remaining amount was kept by the farmers and very little was sold to NCPB outlets.

Table 3.5: Food Stocks in the Study Area (2007)

Where food was stocked (in bags and percentage)						
Food Type	Farmer		NCPB		<b>Local Traders</b>	
	Amount	%	Amount	%	Amount	%
Maize	145,000	45.9	13,000	4.0	158,000	50
Sorghum	420,000	47.7	20	2.3	440	50
Beans	46,000	42.4	1500	1.3	61,000	56
Finger millet	18,000	47.0	1000	0.26	19,000	53

Source: Kisii Central District, 2008

Ideally, most of the food should be kept in storage facilities using technologies that would preserve it to ensure its safety. The eventual sale to private millers and traders would serve to ensure circulation of safe food to the consumers. The National Cereals and Produce Board (NCPB) is mandated to buy and maintain grain on behalf of the government's Strategic Grain Reserves (4 million 90kg bags). In addition, the organization (NCPB) is charged with

organization of commercial grain trading, intervention and stabilization of grain market and distribution of farm inputs (Mbaru, 2009). According to Nyameino (2010) NCPB has not been able to achieve its intended goals as it is not able to procure all grains produced. Furthermore, its price intervention has not stimulated production as intended while its grain distribution is inefficient a situation that impact negatively on household food security.

Food stocks are an important tool in cushioning the impact of food supply shocks by mitigating the increase in food prices and ultimately the impact on food and nutrition security (FAO, 2012). According to Kenya Food Security Steering Group (2011), high post harvest loss of maize is associated with poor storage practices. Maize is the most important staple crop in Kenya beside other traditional crops hence the need for on-farm storage (Waweru, 2014) Flood Disaster Management Group estimates that 30 to 40 percent of the total grain production in rural areas in Kenya is lost due to inefficiencies in post-harvest handling and these impacts negatively on farmer's food security. Most of the cereals are stored in houses due to rampant cases of theft exposing them to the Larger Grain Borer which destroys them. Households without adequate storage facilities are forced to sell their produce exposing them to food shortages.

Decreasing waste and food losses in developing countries can reduce pressure on limited resources land resources (FAO, 2012). Waste and food losses account for almost  $\frac{1}{3}$  of the food produced for human consumption and occur during harvest, storage and consumption in the low income countries. There is need for the introduction of more efficient storage techniques and the resolution of stock management inefficiencies to conserve food to ensure security.

#### 3.3 Research Methods

This section describes the research methods used in the study namely; research design, the study population, sample size and sampling techniques, sample size determination, instrumentation, sources of data, data collection and data analysis procedures.

#### 3.3.1 Research Design

The study adopted a survey design where a specifically defined group of household heads were selected and asked to provide answers to a number of identical questions (Appendix 1). The survey method enables one to obtain relevant facts about the phenomena under study and to be able to state them quantitatively (Baker and Grosh, 1994). The survey design was used in this study because it allows the collection of background information and hard to find data (Busha

and Harter, 1980). The survey method was found ideal for the current study as it made it possible for a large amount of data to be collected.

# 3.3.2 The Study Population

In this study, the sampling frame comprised all rural farm households (3,417) in Kisii Central sub-County who were within  $LH_1$ ,  $UM_1$  and  $LM_2$  agro-ecological zones. It included those who legally owned farms, those who had been allocated family land temporarily and finally those who had leased farms.

Construction of an appropriate sample for both geographical (spatial) and probability methods poses challenges and the reason is that probabilistic methods focus on individuals to provide estimates of a variable's preference within a certain precision, while geographical approaches emphasize the selection of specific areas to study interactions between spatial characteristics and specific outcomes (Vallee, *et al.*, 2007). Despite these challenges, both probabilistic and geographical methods were successfully used.

# 3.3.3 Sample Size and Sampling Techniques

For the purpose of ensuring spatial representativeness of agricultural activities, the study area was purposively divided into the three agro-ecological zones found in the study area as characteristics of each agro-ecological zone were considered to have great influence on land use activities. The LH<sub>1</sub> agro-ecological zone covers Keumbu division and the southern part of Marani, UM<sub>1</sub> dominates Kiogoro, Marani and Mosocho divisions while LM<sub>2</sub> covers a small section of Mosocho which borders Homa Bay district (Figure 3.4). The sub-Location with the highest population density in a given agro-ecological zone was selected as a sampling area. The following sub-Locations were selected from each agro-ecological zone as they had the highest population densities as at the 1999 population census as shown in Table 3.6.

**Table 3.6: Distribution of Sampling Units within Agro-ecological Zones** 

		Population		
Zone	Division	Sub-location	Density	No of Households
$LH_1$	Keumbu	Bomwagi	960	834
$UM_1$	Marani	Ngokoro	927	1,786
$LM_2$	Mosocho	Santa	728	797
TOTAL				3,417

Source: CBS, 2001

Bomwagi sub-Location in Keumbu division was selected to represent LH<sub>1</sub> agroecological zone and Ngokoro sub-Location in Marani division to represent UM<sub>1</sub> zone. Santa subLocation in Mosocho division was selected to represent LM<sub>2</sub> zone. Although, Nyaura subLocation was within the UM<sub>1</sub> zone and had higher population density compared to Ngokoro subLocation it was not included in the study because it borders Kisii Township. Its exclusion is
rationalized on the grounds that the study's main focus was on agricultural land use and the subLocations which border the urban centre (Kisii town) have most of their land dominated by nonagricultural activities including urban settlements.

## 3.3.4 Sample Size Determination

The accessible population was 3,417 households which was the total number of households in the three sub-Locations; Bomwagi, Ngokoro and Santa (Table 3.6). In order to calculate the sample size, the following formula was used as given by Kathuri and Pals (1993).

$$n = \frac{\chi^2 Npq}{\sigma^2 (N-1) + \chi^2 pq}$$

Where:

n = required sample size

N = the given population size

P = population proportion, assumed to be 0.50

q = 1 - p

 $\sigma^2$  = the degree of accuracy whose value was 0.05

 $\chi^2$  = table value of chi-square for one degree of freedom, which is 3.841

Substituting these values in the equation, the sample size (n) was found to be:

$$n = \frac{3.841 \times 3417 \times 0.5 \times 0.5}{0.05^{2} (3417 - 1) + 3.841 \times 0.5 \times 0.5} = 345$$

Proportionate stratified sampling was then used to distribute the 345 households in the three sample areas. This was to ensure that each sample area had a sample size proportional to the total population of the households.

Table 3.7 shows the distribution of the sample sizes in the three sample areas which show that Ngokoro sub-Location in the  $UM_1$  zone with the highest number of households (1,786) contributed the highest proportion (52.3%) of sampling units followed by Bomwagi (24.4%) and finally Santa (23.3%). Simple random sampling method using the 1999 household census report formed the sampling frame that was used to select the households from each cluster (sub-Location).

**Table 3.7: Sample Units from Selected Sub-Locations** 

<b>Sub-location</b>	No of Households	Proportion	Sample
Bomwagi (LH <sub>1</sub> )	834	24.4	84
Ngokoro (UM <sub>1</sub> )	1,786	52.3	181
Santa (LM <sub>2</sub> )	797	23.3	80
Totals	3,417	100	345

Cluster sampling method was used in this study since it does not necessitate extensive sampling frames that would require all farm households in the study area. Instead, sample frames were only required at the village level which is the lowest administrative unit in Kenya.

#### 3.3.5 Instrumentation

Two tools were used to collect data namely; questionnaires and observations. In addition, the study relied on analysis of documents and publications. The questionnaire was a basic tool used to collect primary data (Appendix 1). A questionnaire is a research instrument which consists of a list of questions arranged in some order so as to elicit responses from a respondent. The questionnaire used in this study was structured to secure standardized responses that could be tabulated and treated statistically. Personal interviews based on the questionnaire were then conducted.

Analysis of published information was conducted and notes taken. The review included a critical analysis of reports, documents and substantive research findings on topics related to the study as well as theories and methods used.

Observation as a method of data collection involves observation of participants in their natural setting. Observation was used to provide first-hand experience on farm allocations and household socio-economic conditions. This method provided an objective way of measuring behavior, responses and helps in understanding the farming environment.

#### 3.3.6 Sources of Data

The study used various sources of data which included primary and secondary ones. The following sections give a detailed outline of the sources.

## 3.3.6.1 Primary Sources

The primary objective of this study was to analyze the impact of agricultural land use on household food security. Farm households were, therefore, the main source of information. This is because they are the basic unit of agricultural production. Household heads provided information on their age, gender, marital status and education level. Information on household socio-economic characteristics was also provided namely household size and composition, land tenure, farm size, and household income. Information on agricultural production and extension services was also recorded. Primary data on farmers' assessment of the impact of the physical environment (land configuration, rainfall, soils, wind) on agricultural activities was also collected.

In order to collect information on allocation of land among different land uses, agricultural activities were categorized and the amount of agricultural land allocated to them by households recorded. The study conceptualized agricultural land use as comprising four categories; **cash crop** land use included all land allocated to tea, coffee and sugarcane production and **food crop** land use was land allocated to maize, beans, bananas, sorghum, finger millet and sweet potato. **Fruits and vegetable** was the third category which referred to all the land used to grow avocados, pineapples, paw paws, cabbages, kales, onions, tomatoes and traditional vegetables and finally **pasture and napier grass** included all land used to grow napier grass and/or natural pasture for livestock keeping.

Based on the experience-based method, the respondents were asked to assess the food security status of their households in the twelve months preceding the study in reference to different sources and coping strategies. Their assessment focused on food available at the household from all food sources, that is; 'own farm production', 'purchasing', 'working for

food', and 'gifts in form of food'. The food security status of households was categorized as 'adequate food', 'mild shortage (1 - 2 months)', 'shortage (3 - 5 months)' and 'severe shortage (more than 6 months)'. The reason for this categorization was to provide an insight into the food availability or accessibility within households in reference to different periods / seasons of the year. This method was used by Amaza *et al.* (2009) in the study of changes in household food security and poverty status in Southern Borno State, Nigeria.

Information on food produced by households within the study period was recorded as well as consumption of basic foods not in calories but in amounts as required by households, period of shortages and coping strategies in case of food shortages. However, it is important to note that although people's own perception of food needs is an important aspect of household food security, data collection based on self-report may have some short-comings. One of the main weaknesses is that households may deliberately distort their response in order to gain development assistance (Maitra and Rao, 2014). Despite this challenge, household heads were encouraged to provide accurate information on their food security situation.

# 3.3.6.2 Secondary Sources

Secondary data related to agricultural land use and food security was derived from several sources; official agricultural records from the Kisii Central sub-County Agricultural Office, Ministry of Agriculture Annual statistics and Statistical Abstracts from the Kenya National Bureau of Statistics. Other publications reviewed included policy publications from national and international organizations, for example, Sessional Paper No. 4 of 1981 on Food Policy, published works from Tegemeo Institute of Egerton University, Kenya Food Security Steering Group, the International Food Policy Research Institute, Food and Agricultural Organization, and World Bank, among others. Other sources included scholarly research papers published in refereed journals and post-graduate theses. Information gathered from these sources focused on demographic characteristics, farm management, agricultural production levels, issues of food security and empirical findings on relationships between/among food security and agricultural land use and household characteristics. This information was used in discussion in various sections of this study.

### 3.3.7 Validity and Reliability

Validity is the degree to which the method used in collecting information results in accurate information (Madrigal, 1999). It was therefore necessary for the questionnaire that was used for data collection to be as accurate as possible. To ensure that the data gathered was valid and reliable the questionnaire was checked by research experts at the faculty and the instrument pilot tested to make necessary adjustment before embarking on data collection.

The questionnaire was pre-tested for three days in December 2005 where each enumerator was given ten questionnaires to administer on respondents purposefully selected from the sub-County. Analysis of the pilot survey questionnaires showed some problem areas that might have led to biased or inconsistent responses. For example, it was realized that questions relating to food consumption were not clear, secondly, most respondents were more familiar with land measurement in acres and not in hectares, and thirdly, most women even when they were household heads, were unwilling to provide information unless a male relative or family members were present. Changes were made to the questionnaire in regard to the issues raised and it was decided that female household heads were to be encouraged to provide the required information with minimum involvement of other people.

#### 3.3.8 Data Collection

Research data was collected between March and August 2006 after the researcher was granted a permit by the government (Appendices 2 and 3). This study depended on primary data collected from farm households. This is because the farm is regarded as a focal point in geographical investigation, and is essential in understanding the spatial patterns of agriculture. The main source of information at the household level was the head of the household or in their absence, the spouse responsible for decision-making.

Data was collected using a standard questionnaire (Appendix 1). The questionnaire was written in English and the interviews were conducted in the English language whenever possible or the questions were translated into *Ekegusii* for those not familiar with the English language. This was to ensure uniformity and clarity of the questions and answers. Three research assistants were recruited to assist in data collection. All of them had post-secondary level of education, a good understanding of the geography of the area and good interpersonal skills among other factors. The research assistants were trained for two days on interview procedures and the

objectives of the research were clearly explained to them. This assisted in ensuring that the survey questions were well understood across all research assistants in order to minimize errors.

Identification of the respondents from each sub-Location was done with the help of the sub-chiefs and other local administrators (village headmen). Sub-chiefs were used as entry points for logistical purposes. They helped to provide lists of all villages within the selected sub-Locations. Based on the lists, simple random sampling techniques were used to pick the respondents. The village headmen assisted in locating the households that had been picked within their villages. The headmen were also cooperative in creating awareness of the study as it had been sanctioned by the government through issuance of permits (Appendices 2 and 3).

Although the study targeted a sample size of 345 household heads, only 209 household heads were able to provide accurate information which was used in data analysis. A large number of questionnaires were excluded from the analysis and the main problem was the inconsistency of responses. Some respondents could not recall production and consumption data as most of them kept no farm records. In some cases, data on farm size and farm allocations could not tally. Female headed households also contributed to the problem of inconsistency of responses by not being forthright in issues related to land and income levels.

The assumption that the higher the response rate (≥80%) the better the study, has led to the creation of certain rules like the 60% minimum response rate for survey studies, however, there is no firm statistical basis for this proportion (Livingston and Wislar, 2012). According to Baruch and Holton (2008), scholars have suggested minimum levels of response rate such as 45% and 50%, but these suggestions are not based on data and they lack consistency across literature. Babbie (1990), Roth and Bevier (1998) suggest 50% as the minimal level; Fowler (1984), suggests 60% and De Vaus (1986) argues for 80%. A study by Baruch and Holton (2008) which analyzed research papers published in seventeen academic refereed journals between the year 2000 and 2005, found that the average response rate to be about 52.7%. Therefore, based on these arguments, the 61% response rate was considered sufficient for this study.

# 3.3.9 Data Analysis

Data from questionnaires that had been checked for their completeness, clarity and consistency were organized and then coded before entry into the computer. Analysis was done in 2012 using the Statistical Package for Social Sciences (SPSS) version 17.0 to generate the

required statistics. Since the study was about the implication of different land uses on household food security, it was necessary to analyze the relationship between the four categories of agricultural land uses and household food security. The dependent variable was the household food security situation, while the four agricultural land uses and household socio-economic characteristics were the independent variables. Agricultural land use was treated as a dependable variable in the analysis of the influence of household socio-economic characteristics.

Although data on household food security situation was based on four categories (adequate food, mild shortage, shortage and severe shortage), for the purpose of this study, households were considered to be either food secure or food insecure. Households which reported no shortage and those with mild shortage (1-2 months) were grouped together and named food secure. Households with mild shortage were considered food secure because they are normally able to access food through early harvesting or skipping of one meal and are therefore not at the risk of being malnourished. Households who experienced a shortage (3-5 months) and those with severe shortage (more than 6 months) were also grouped together and considered to be food insecure. Therefore, there were only two categories; food secure and food insecure households whose relationship with the four categories of land uses were sought. Analysis of the impact of household socio-economic characteristics on household food security situation and agricultural land use was also done.

Data was analyzed using both descriptive and inferential techniques as shown in Table 3.8. The first step in data analysis involved generation of statistical summaries such as frequencies, percentages, means, sums and modes. Out of these frequencies and percentages, tables, bar graphs and pie charts were constructed in order to help in the description of the characteristics of the sample population. The Chi-square test was used to analyse the implication of agricultural land use on household food security situation and also the influence of household socio-economic characteristics on agricultural land use and household food security situation. This test was used to check whether a systematic association existed between two or more variables that had been cross-tabulated. Cross tabulation approach was found to be relevant because most of the data was in nominal form. On the basis of the cross-tabulation, frequencies were calculated and the value of Chi-square then worked out. By comparing the calculated value with the table value of Chi-square ( $\chi^2$ ) for n-1 degrees of freedom at significant level of 0.05, the

null hypothesis was either rejected or accepted. Small values of  $\chi^2$  indicate absence of a significant relationship while large values show that a systematic relationship of some sort exists between variables.

The formula for calculating the chi-square is given as;

$$\chi^2 = \sum \frac{\left(O_{ij} - E_{ij}\right)^2}{E_{ii}}$$

Where  $\chi^2$  = chi-square value

Oij = observed frequency of cell in i<sup>th</sup> row and j<sup>th</sup> row

Eij = expected frequency of cell in i<sup>th</sup> row and j<sup>th</sup> row

Only chi-square values significant at 0.05 ( $p \le 0.05$ ) and above were considered as representing significant relationships. For instance, the study intended to find out whether growing cash crops had an impact on household food security situation. In such a situation, the assumption was that the two variables were independent of each other, which means that growing cash crops had no effect on household food security situation. On this basis, the frequencies were first calculated and the value of Chi-square worked out. All calculated values of  $\chi^2$  found to be less than their table value at 0.05 confidence level ( $p \le 0.05$ ) meant that the two attributes, for example, growing cash crop and the household food security situation were not associated. However, in the event that the calculated value at 0.05 or less level of confidence was greater than the  $\chi^2$  table value, the conclusion was that the two variables were associated, and that the association was not due to some chance factor.

The characteristics of Chi-square test that were significant in relation to this study were; that the test is based on frequencies, that the test can be applied to complex contingency tables with several classes as was the case and finally, that the test requires no rigid assumptions in regard to population and is relatively less mathematical. The application of chi-square test as a measure of significance between variables however requires that observed as well as expected frequencies are grouped in the same way. The other conditions for the application of chi-square test are that data must be collected on a random basis. According to Yates *et al.* (1999), each observation should be independent of all others, no more than 20% of the expected counts should

be less than 5 and all individual expected counts should be one or greater in a 2 x 2 contingency table. However, the minimum expected count of five appears to have been arbitrary choice and Cochran (1952) suggested that it may need to be modified when new evidence became available. In this study, the power of the Chi-square test was associated with a larger number of observations, therefore, in cases where there were very few observations (less than five) in more than 20% of the cells the test results were deemed invalid. One other important condition for the application of Chi-square test was that the sample size should be reasonably large. This study met the condition and all other assumptions.

It was observed in this study that although  $\chi^2$  is important in determining the association between two or more categorical variables it is not a measure of the degree (strength and magnitude) of the relationship between the two variables. It only shows the significance of the relationship between two variables but does not provide an indication about the strength and magnitude of the association between variables. Therefore, in cases where the  $\chi^2$  test indicated a statistical significance between two or more categorical variables, the study sought to determine the degree (strength and magnitude) of association so as to interpret the relationship between them. This was because, even though a chi-square test may show statistical significance between two variables, the relationship between those variables may not be substantively important.

There was therefore, a need for further analysis of the  $\chi^2$  results to help evaluate the relative strength of a statistically significant relationship or difference. The calculated  $\chi^2$  value was converted into some common measures of association (correlation) specifically the Phi Coefficient, and Cramer's V depending on the dimensions of the contingency table defined by the number of categories of the variables. Given the nature of the variables used to calculate each of these statistics, the obtained values for each statistic fall between 0 (no relationship) and 1 (perfect relationship). The closer the values are to 1, the stronger was the association or correlation between the two variables, and vice versa. In describing the strength of association, a value of > 0.5 suggests a high/strong association or relationship while values ranging from 0.3 to 0.5 indicate moderate association or relationship. Values of 0.1 to 0.3 show low association/relationship. The appropriate measure of correlation was determined by the

characteristics of the data and the dimensions of the contingency table (number of rows and columns).

**Table 3.8: Summary of Data Analysis** 

<b>Research Question</b>	Independent	Dependent	Statistical
	Variable	Variable	Techniques used
1). Which are the main agricultural	Study area	Land use	Frequencies,
land use activities in the study area?			Percentages,
2). What is the status of household	Household	Household food	Frequencies,
food security in the study area?		security status	Percentage
3). How does agricultural land use	Land use	Household food	Chi square,
affect household food security in the		security status	Phi Coefficient,
study area?			Cramer's V
4). How do the household socio-	Socio-	Household food	Chi square,
economic characteristics influence	economic	security status	Phi Coefficient,
agricultural land use and household	characteristics		Cramer's V
food security in the study area?			

# CHAPTER FOUR RESULTS AND DISCUSSION

#### 4.1 Introduction

In this chapter a discussion on the research findings based on the objectives of the study is presented. It covers a description of the socio-economic characteristics of the study population, an examination of the various agricultural land use activities in the study area, and an assessment of household food security. A discussion on the third objective of the study which sought to establish the relationship between agricultural land use and household food security has also been presented. In addition there is a discussion on objective four of the study which sought to determine the influence of selected household socio-economic characteristics on land use and household food security. At the end of the chapter is a summary that captures the main conclusions of the study.

# 4.2 Socio-Economic Characteristics of the Study Population

As mentioned above the socio-economic characteristics of the sampled population are described in this section. These include age, gender, marital status and the education level of the household head. Also described are household characteristics such as size and composition, land tenure, farm size, household income and agricultural extension and technology. The section also covers a household heads assessment of the physical environment and its impact on agricultural activities. Environmental factors discussed include land configuration, rainfall, soils and wind. All these variables play a significant role in determining and enhancing agricultural production and, hence, household food security.

# 4.2.1 Age of Household Heads

Age is an important socio-economic factor in the management and distribution of roles in a household. Age defines the various roles played by different people in society and influences decision-making power at the household level especially in relation to land use and food situation. In this study, the respondents were aged between 21 and 78 years with a mean age of 43.98 years.

**Table 4.1: Distribution of Age Categories among Household Heads** 

Categories	Frequency	Percent	
21-30	25	12.0	
31-40	61	29.2	
41-50	63	30.1	
51-60	49	23.4	
61-70	8	3.8	
71-80	3	1.4	
Total	209	100.0	

Source: Research Data, 2012

Table 4.1 indicates that only 12% of the sample population was aged between 21-30 years. This low proportion could be because most young people are normally in school and may not establish their own households. Also, some of the people in this category may not have inherited or bought land of their own. Most respondents (59.3%) were found to be between 30 and 50 years of age. These results compare favourably with those of Ogeto *et al.* (2013) who found that majority of the farmers in Nakuru County are aged between 30 to 59 years with an average age of 43 years. People in this age group are potentially energetic thus expected to cultivate larger farms compared to those who are older. Additionally, those in the 30-50 age brackets may have the ability to seek and obtain off-farm jobs and income. The age distribution suggests that most respondents are mature, energetic and able to actively participate in farming activities.

#### 4.2.2 Gender of Household Heads

Gender is a significant factor of consideration, especially in agriculture. This is mainly because of the division of labour aspect in which different genders are assigned specific roles to play in this sector. Gender is also important because it influences farm organization and income earning opportunities of a household. From Figure 4.1 it can be observed that 81.3% of the households were headed by males and 18.7% by females. This shows that there were more male headed households than their female counterparts, a situation reflected in most rural areas in Kenya where 70% of households are male headed while 30% are female headed (CBS, 2005). The high incidence of male household heads in farming households in the study area could be

due to the fact that the males find involvement in farm activities a viable livelihood alternative to seeking for employment elsewhere.

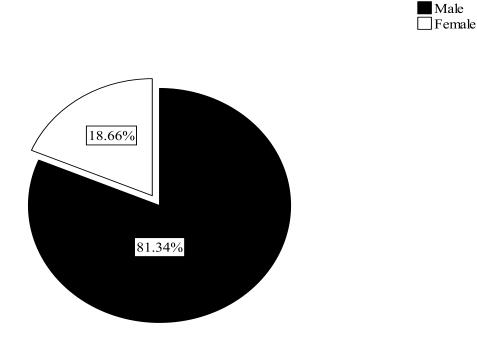


Figure 4.1: Distribution of Gender among Household Heads

Source: Research Data, 2012

There is evidence that female headed households vary inversely with the economic potential of the area and that incidences of female headed households seem to be high in areas of low agricultural productivity. A study in Malawi by Chipande (1987) revealed that areas of high agricultural potential had only 16% of the households headed by women. Another study by Auma *et al.* (2010), equally indicated that in some areas of Homa Bay and Rachuonyo sub-Counties which are characterized by unfavourable climatic conditions, hence low agricultural potential, had a high incidence (46%) of female headed households due to male labour migration.

The head of the household is seen as a source of authority which is often determined by culture, economic contribution, among other factors. The cultural issues in the study area where only males are allowed to inherit land creates a situation where women only have user rights to

land granted by men (*de facto*). Therefore, there is unequal participation of women and men in socio-economic activities and this gender disparity affects women in terms of control, ownership and accessibility to productive resources and participation in decision making (Kisii County, 2013).

Gender is a central factor in household decision making which affects agricultural productivity, time allocation and investment in developing countries (Fawehinmi and Adeniyi, 2014). Many studies have shown that women play a predominant role in household food security through participating in agricultural and food production (FAO, 2009). In most African countries, women have no independent rights to allow them control or produce from the land (Adekola *et al.*, 2013).

#### 4.2.3 Marital Status of Household Heads

A household's economic stability largely depends on the contribution of household members in terms of farm labour and participation in off-farm activities. For example, it is possible for married couples to share responsibilities on the farm for the production of different crops, an arrangement which may allow one spouse to engage in salaried or wage employment outside the farm. In sub-Saharan Africa, men traditionally owned land but plots of land are cultivated or managed jointly by women and men. Men clear the land and women undertake most of the remaining activities like weeding and processing of harvests (FAO, 2002). This implies that such households have diverse ways of earning livelihoods compared to those who are single or widowed. Out of the sample, 93.8% were married and only 2.4% and 3.8% were single/divorced/separated and widowed, respectively as shown in Table 4.2. This shows that most farms (93.8%) were worked by married couples probably with children whose food needs and other necessities had to be met.

**Table 4.2: Distribution of Marital Status of Household Heads** 

Marital status	Frequency	Percentage (%)
Married	196	93.8
Single/divorced/separated	5	2.4
Widow/widower	8	3.8
Total	209	100.0

Source: Research Data, 2012

Studies show that the marital status of the household head has a positive and significant association to household food security (Haile *et al.*, 2005 and Kaloi *et al.*, 2005). While confirming these findings in Ghana, Aidoo *et al.* (2013) further indicated that households headed by unmarried people were likely to be food secure than those headed by married ones because households with married people may have larger households and this means many mouths to feed.

#### 4.2.4 Education Levels of the Household Heads

Levels of literacy and education among household heads affect agriculture in several ways. For example, education determines the absorption of extension information and the sort of off-farm employment one can undertake and even the amount of income that may be earned. These in turn may influence the standard of living of the households and determine access to food, land and other resources. Figure 4.2 presents the distribution of levels of education among household heads.

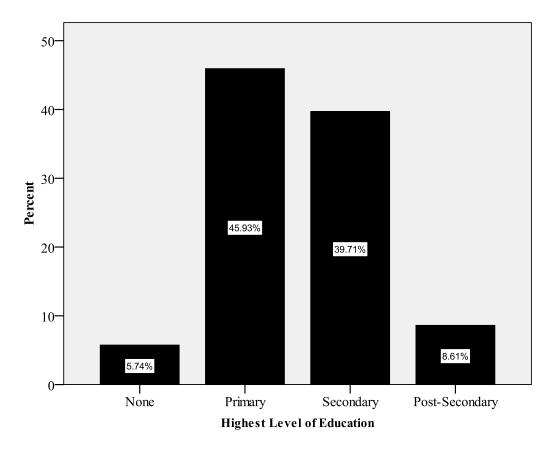


Figure 4.2: Distribution of the Level of Education of Household Heads

Source: Research Data, 2012

Analysis of the survey data indicated that 5.7% of the household heads had no formal education, 45.9% had attained primary level, and 39.7% had secondary level of education, small proportion (8.6%) had post-secondary education. This implies that most household heads had attained primary and secondary levels of education (85.6%). These findings are in line with Ogeto *et al.* (2013) who found that majority (83.6%) of farmers in Nakuru County had primary and secondary school education. According to Wakili (2012) higher education is imperative for better understanding and adoption of new technologies. Illiterate farmers require simple extension information that is easily understood and these are normally in the form of audiovisuals, personal contact as well as demonstrations. Furthermore, low levels of formal education amongst household heads restrict them from seeking formal employment and are forced to largely depend on agriculture.

# **4.2.5** Household Size and Composition

According to the results of the analysis as shown in Figure 4.3, 23%, 62.2% and 12.9% of the households had between 1-5, 6-10, 11-15 and more than 15 members, respectively. This implies that majority of the households had six people and above giving a mean of 7.64. The results show that households in the study area were larger than the sub-County average of 5 people and the national household average of 5.1 at the time of the study (KNBS, 2005/06). These findings differ slightly from those of Nyangweso *et al.* (2011) who found a household size of 6.0 in the comparable Vihiga District, Kenya.

The high average household size was due to the fact that the area has a high population density which was expected to reach 1056 persons per square kilometer by the year 2012 (Kisii Central District, 2009).

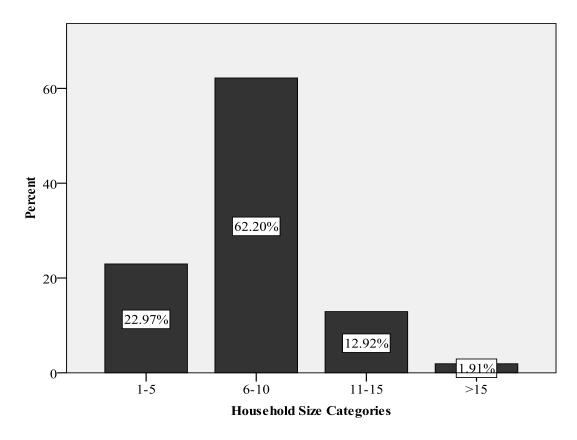


Figure 4.3: Distribution of Household Sizes

Source: Research Data, 2012

Data on the number of children under the age of 15 years were also sought. Children normally depend heavily on adult members of their households for most of their needs and provide little labour for farm chores. In the study area, about 92% of the households had between 1 and 6 children below the age of 15 years. In a household, the number of dependants determines food demand and consumption levels which may affect both production and household purchasing power. More food is required to feed them and they may need more income for necessities such as school fees and medical expenses which may reduce a household's capability to purchase food. According to Nord and Andrews (2003), food security depends on household structure and composition. In their study on household food security in United States they found that food insecurity was least common among household consisting two or more adults with no child present.

#### 4.2.6 Land Tenure

Land tenure systems generally determine who can use land, for how long and under what conditions. In the study area, the sampled household reported to have acquired land through several methods as presented in Table 4.3.

**Table 4.3: Land Acquisition Methods** 

Method	Frequency	Percentage (%)
Inheritance	196	93.8
Lease	44	21.1
Purchase	26	12.4
Temporal family allocation	7	3.3

Source: Research Data, 2012

Note: Households had more than one method of land acquisition

As indicated above, a large proportion of households had acquired land through inheritance (93.8%), while 21% had leased farms, 12.4% had purchased land, and only a small proportion of households, (3.3%) had been allocated land temporarily by their families. This implies that most households had rights to the land under their care and could make decisions on how the farms should be used. Secure land tenure (with title deeds) has a positive effect on the efficiency of smallholder farms and also promotes investment in soil and water conserving structures (Ogada *et al.*, 2010). Those with temporary allocation and those who had leased land had limited access and may not have been at liberty to utilize it the way they desired and this might have affected their land use choices.

Research findings indicated that 41.6% of the sample population had title deeds for their farms. This is confirmed by the Kisii County Integrated Strategic Plan 2013-2017 which states that only about 40% of the households have title deeds and the reason for this low proportion is because of the costs associated with the processing of title deeds among other factors (Kisii County, 2013). Legal land ownership ensures that households are able to access agricultural development loans using titles as securities. Land ownership, accessibility and sustainability are very crucial to agricultural development as they influence food supply, better housing and reliable income in most cases (Adekola *et al.*, 2013).

#### 4.2.7 Household Farm Size

Farm size determines households' economic well-being because larger pieces can be easily divided up for various agricultural enterprises (for example, food and cash crop production as well as keeping of livestock) and these may increase household incomes. The distribution of farm sizes among sample households was as follows; about 20.1% owned to less than 1 acre, 48.3% owned between 1.0 and 2.0 acres and 31.6% owned over 2.0 acres (Table 4.4). The average farm size was 2.08 acres although most households (68.4%) owned less than the average.

**Table 4.4: Distribution of Household Farm Sizes** 

Size	Frequency	Percentage (%)
< 1 acre	42	20.1
1-2 acre	101	48.3
> 2 acres	66	31.6
Total	209	100.0

Source: Research Data, 2012

According to Jaetzold *et al.* (2009), a family of 5 people living in UM<sub>1</sub> and LH<sub>1</sub> agroecological zones requires 1.6 hectares to make a decent living. The amount of arable land available for households in the study area however ranges between 0.4 hectares and 0.8 hectares with an average of 0.5 hectares (Ibid). This shows that low farm size is a major constraint to the livelihoods of most people in the study area because households may not be able to produce enough food and generate enough income from agriculture to purchase food and other basic requirements.

Land is the most valuable form of property in agrarian societies because of its economic, political, symbolic and ritual importance and it is used for production of biomass, ensuring food, fodder, renewable energy and raw materials for existence of human and animal life (Adekola *et al.*, 2013). In most developing countries land is not only the primary means of generating livelihoods but often the main vehicle for investing, accumulating wealth and transferring it between generations (FAO, 2006). Therefore, the amount of land and the ways in which that land is utilized has broad implications for food security.

Households often lease land to boost their agricultural activities. Only about 21.0% of the respondents had leased land during the survey period and among them, 63.6% had leased farms ranging between 1.0 and 2.0 acres while 27.3% had leased less than 1.0 acre (Table 4.5). Most of the leased farms were small mainly because farm sizes in the study area are generally low. Leased land normally has no security of tenure and may not be used for production of cash crops therefore, it is often used for production of perennials such as maize, beans and napier grass.

Table 4.5: Distribution by Size of Leased Land by Sample Households

Size	Frequency	Percentage (%)	
< 1 acre	12	27.3	
1-2 acre	28	63.6	
> 2 acres	4	9.1	
Total	44	100.0	

Source: Research Data, 2012

#### 4.2.8 Household Income

The sampled households reported that they received their incomes from several sources namely: agricultural sales, salaries of those employed, gifts from family members working in the off-farm sector, sale of property, small businesses or trade, and merry-go-rounds among others. Total household income was unevenly distributed among the sampled households with a minimum of Kshs 1200 and a maximum of Kshs 750,000 per year (Table 4.6).

Table 4.6: Distribution of Household Income among Sample Household Heads

Income (Kshs '000')	Frequency	Percentage (%)
<120	161	77.0
120-240	33	15.8
240-360	10	4.8
360-480	1	0.5
>480	4	1.9
Total	209	100.0

Source: Research Data, 2012

According to the survey data, it is clear that majority of the households (77%) earned less than Kshs. 120,000 per year, 15.8% earned between Kshs. 120,000 and Kshs. 240,000 per year and only 7.2% earned above Kshs. 240,000. The average household income was Kshs. 95,800, implying that on average, households earned about Kshs. 8,000 per month. This amount may not be enough to meet the requirements of households, thus exposing them to food insecurity.

According to Jaetzol *et al.* (2009), a rural family of 5 persons required Kshs 172,500 per year (using 2009 prices) to be food secure and also to meet other household needs. They required Kshs 8,900 to produce the required 7.5 bags of maize (1.5 bags per person per year), Kshs 3,500 to produce 2.5 bags of beans (0.5 bags per person per year) and Kshs 160,100 for school fees, medical, shelter, clothing and others. Households were therefore required to have a monthly income of about Kshs 14,000 to be able to provide for their basic needs. Households may have been constrained to make ends meet given the fact that the average income is far less (Kshs 8,000) than the amount required in 2009 given that prices of commodities have continued to rise. Despite the fact that the area is richly endowed agriculturally, the high population, low agricultural productivity and limited off-farm job opportunities have resulted in high food poverty level (60%) and a large proportion of the population (49.6%) live below the poverty line (GoK, 2013).

Agricultural income was one of the sources of household income. This accrued from sale of agricultural produce like tea, coffee, maize, beans, bananas, fruits, vegetables, livestock, poultry and milk. The amount of agricultural income earned in a household depends on the type of commodities, amount produced and sold and the prevailing prices for those products. Majority of households (96.2%) earned income from agriculture. Aggregated earnings from agricultural activities are presented in Figure 4.4.

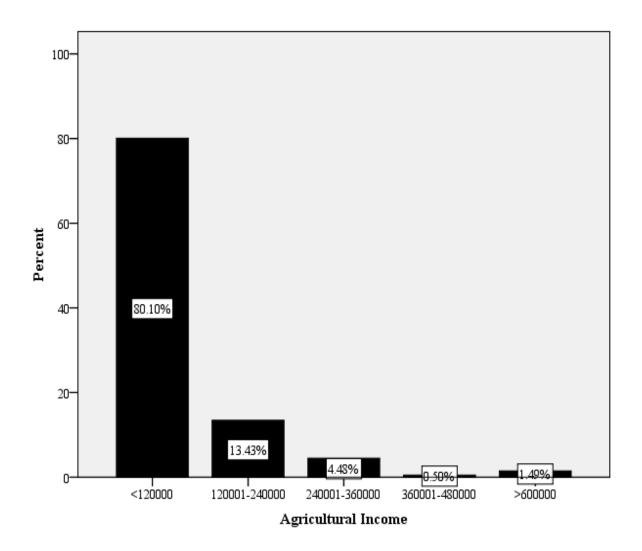


Figure 4.4: Distribution of Agricultural Incomes among Sample Households Source: Research Data, 2012

Analysis of Figure 4.4 shows that 80.1% of the households earned less than Kshs. 120,000, 13.4% earned between Kshs. 120,000 and Kshs. 240,000 and only 6.5% earned over Kshs. 240,000 per year. The average agricultural income was Kshs. 81,500 per year which suggests that majority of the households earned less than Kshs. 10,000 from agriculture per month. This is the income threshold that could be used to measure household heads' access to basic needs and also investment in agriculture in form of purchase of inputs and payment for agricultural labour. The average income of households was about Kshs. 95,800 per year suggesting that agricultural activities contributed the largest proportion to household income and

could be the main determinant of the households' economic and food security status in the study area.

Sources of agricultural income were categorized according to different land uses as shown in Table 4.7. The purpose of categorizing was to provide a better understanding of the contribution of different land use activities to the economic well-being of households and their food needs.

**Table 4.7: Distribution of Agricultural Income from Different Land Uses (Kshs)** 

Statistic	Cash crop	Food crop	Fruits / Vegetable	Pasture / Napier
Average	27,500	17,500	14,600	18,700
Maximum	446,000	205,000	317,000	295,800

Source: Research Data, 2012

Further analysis of the agricultural income showed that households obtained most income from sale of cash crops with a maximum of Kshs. 446,000 and an average of Kshs. 27,500 per year. Pasture and Napier grass land use was the second most important contributor with an average of Kshs. 18,700 per household per year, followed by food crops at Kshs. 17,500, and lastly fruit and vegetables which contributed Kshs. 14,600 per household per year. Cash crop, pasture and napier land use activities, therefore, provided the most income as the products from these types of land uses are essentially for sale. Food crops as well as fruits and vegetables are mainly for subsistence although some proportion may be sold to earn some revenue for purchase of essentials. For example, the results of the analysis show that about 18.5 % of the maize, 16.9% of beans, 16.5% of vegetables and about 7% of finger millet yields were sold after harvest. The implication was that households engaged in income generating activities like cash crop production had higher incomes and were likely to be food secure.

Another source of household income was salaries and wages. A number of respondents (32%) indicated that they earned salaries or wages. Table 4.8 shows the distribution of this income.

Table 4.8: Distribution of Salaries / Wages among Sample Households

Amount (Kshs '000')	Frequency Percentage (%	
<10	11	16.4
10- 50	34	50.7
50- 100	15	22.4
>100	7	10.5
Total	67	100

Source: Research Data, 2012

As shown in Table 4.8, 16.4% of the respondents received salaries and wages amounting to less than Kshs. 10,000 while about a half (50.7%) earned between Kshs. 10,000 and Kshs. 50,000 per annum. The rest (32.9%) earned over Kshs. 50,000 per annum with the average amount earned being Kshs. 46,400 per annum. Considering the fact that to a large extent, off-farm earnings depend on the level of education and training of a household head and that only 8.6% had attained post-secondary education, most of the household heads may have been engaged in low paying jobs. This could be the explanation for the large proportion of respondents (67.1%) earning Kshs. 50,000 and below per year. Salaries and wages are however, important sources of household income and may go a long way in boosting the purchasing power of the households thereby improving their household food security situation.

Besides, income from agriculture and salaries and wages, about 59% of the sample household heads received some income as cash remittances, gifts from friends and relatives and from sale of assets. Cash remittances were mostly received on a monthly basis. Assets such as livestock were sold when there was need while gifts were occasionally received within the study period. Thirty eight respondents (31%) received less than Kshs. 10,000 per year while the majority (59%) received between Kshs. 10,000 and Kshs. 50,000. Only 10% received above Kshs. 50,000 (Table 4.9).

Table 4.9: Distribution of Income from Cash Remittances, Gifts and Sale of Assets

Amount (Kshs '000')	Frequency	Percentage (%)	
<10	38	31	
10 - 50	73	59	
>50	12	10	
Total	123	100	

Source: Research Data, 2012

The average earnings from cash remittances, gifts and sale of assets were about Kshs. 9,400 per year per household head. These amounts were low compared to earnings from agriculture (Kshs 95,800) and salaries and wages (Kshs 46,400) which implied that its impact on the wellbeing of households in the study area may not have been significant. Although financial transfers along with returns from farming, salaries and/or wages constitute main sources of income for rural households and in Kenya, these transfers however form a small percentage of rural revenue (World Bank, 2006). About 74% of rural household receive cash transfers and about 13% - 14% of this remittances are spent on food thus contributing to food security (Ibid).

Evidence suggests that household income is an important determinant of household food security mainly because food insecurity is no longer seen simply as a failure of agriculture to produce sufficient food, but instead, as a failure of livelihoods to guarantee access to sufficient food to people at household level (Devereux and Maxwell, 2001). In Kenya, the poor are defined as those who survive on 1 US dollar or less a day, therefore, for an average household size of 5 the poverty line is at Kshs 12,245 (177 US dollars) or less per month (Olielo, 2013). The average monthly income in the study area was about Kshs 8,000 for households averaging about 8 people. This indicates that some of the households survived below the poverty line making it difficult for them to purchase food in case of shortages.

## 4.3 Agricultural Extension and Technology

Extension services play a significant role in disseminating agricultural knowledge and techniques to farming communities. For instance, extension workers help farmers to translate research findings into improvement of livelihoods through efficient utilization of their resources.

In the study area, the respondents had access to various sources of agricultural information namely; extension workers, neighbours, mass media and agricultural organizations among others. Information on the type of contacts between households and extension workers was also collected to gauge how farm households relate to agricultural extension personnel. There were three types of contact between household head and extension workers namely; farm visits, office consultation and barazas or field days (Table 4.10).

Table 4.10: Frequency of Contact between Household Heads and Extension Workers

Contact Type	Frequency	Percentage (%)
No contact	139	66.5
Farm visits	41	19.5
Office consultation	7	3.5
Barazas / field days	22	10.5

Source: Research Data, 2012

As observed in Table 4.10, majority of the household heads (66.5%) had no contact with the extension workers in the 12 months preceding the study. Farm visits by extension workers were therefore, the most preferred method of contact (19.5%) followed by barazas / field days (10.5%) while only 3.5% of the household heads visited local agricultural offices for consultation. These results indicate that most household heads did not take the initiative to seek extension services as the policy currently stipulates. This may have had a negative impact on farming because agricultural extension plays a crucial role in promoting agricultural productivity and improving rural livelihoods through agri-business, thereby boosting food security.

The importance of agricultural extension in relation to the fight against poverty has been laid out in the Strategy to Revitalize Agriculture (GoK, 2004). Agricultural extension services improve the knowledge base of farmers and provide information such as crop varieties, new seed varieties, crop prices and training in new technologies among others (Munyanga and Jayne, 2006). Over the years the Kenya government has tried a number of extension styles including progressive or model farmer approach, integrated agricultural development approach, farm management, Training and Visit (T&V), farming systems approach and Farmer Field Schools (FFS) (IFPRI, 2011). Traditionally, small-scale farmers in Kenya have benefited through two

types of extension; the government extension service mainly focused on food crops and the commodity-based extension mainly run by government parastatals, out-grower companies and cooperatives. As a result of flaws in public extension services, a third type of extension services has emerged; the privatized agricultural extension initiatives provided by private companies, non-governmental organizations, community-based organizations and faith-based organizations (IFPRI, 2011; World Bank, 1999).

The National Agricultural Livestock Extension Programme (NALEP), the government extension service has programmes aimed at enhancing the contribution of agriculture and livestock to social and economic development and poverty alleviation by promoting pluralistic, efficient and demand driven extension to farmers and agro-pastoralists (Munyanga and Jayne, 2006). However, there are concerns about the inclusion of both public and private extension delivery methods in reaching the target farmers and producing expected results of lifting standards of living of smallholder rural farmers (IFPRI, 2011). A study by Mikalsta (2010) in Western Province, Kenya revealed the inability of the current extension system to disseminate existing and new technologies to farmers. She found that access to extension services was a problem to both genders where only 21% of the women and 20% of the men in the sample had access to extension services yet research findings showed that extension services had a large and significant effect on maize yields.

Information on the type of technologies used in agricultural production in the study area indicated that about 51.0% of the respondents apply fertilizer on their farms. Use of improved seeds particularly of maize was popular with about 76.0% of the households using different varieties of hybrid. Use of other types of technology such as agrochemicals and machines was minimal because they are considered to be expensive by the households.

#### 4.4 Examination of Various Agricultural Land Use Activities in the Study Area

This section focuses on the first objective of this study which was to examine the various agricultural land use activities in the study area. Description of the main land use types has been presented together with a discussion on the agricultural activities associated with the four agricultural land uses namely; food crop, cash crop, fruits and vegetables and pasture and napier grass. The discussions revolve around cultivation of various crops, the amount of land allocated to different farm enterprises and production levels among others.

#### 4.4.1 Food Crops

The survey data showed that maize was the most popular crop among food crops with almost everybody (98%) growing it on field sizes ranging between 0.03 to 3.5 acres. The average production was about 8 bags per household per year of which about 18.5% of the harvest was sold. Households required an average of about 8.4 bags of maize per year for their subsistence (Table 4.11a). Beans were grown by about 87% of the sampled households often intercropped with maize and coffee. Its average field size was 0.67 acres but its production was low with an average of 1.4 bags per household per year. Households required about 1.7 bags of beans per year for their domestic consumption. About 17% of the beans harvested were sold to earn income.

**Table 4.11a: Food Crop Production** 

Crop	Freq.	% of farmers	Field size (acres)	Mean field size(acres)	Ave. prod per hhold /year	Ave. amt required per hhold/year
Maize	205	98.0	0.03 -3.5	0.63	7.5 bags	8.4 bags
Beans	182	87.1	0.02 - 3.5	0.67	1.4 bags	1.7 bags
Bananas	161	77.0	0.03 - 2.75	0.23	61	-
Sorghum	36	17.2	-	-	-	-
Potatoes	36	17.2	-	-	-	-
F/millet	14	6.7	0.01 -1.00	Negligible	0.5 bags	-

Source: Research Data, 2012

A large proportion of sample households grow bananas on field sizes ranging from 0.03 to 2.75 acres with a mean field size of 0.23 acres. Households reported an average production of 2 to 3 MT, but it was not possible to ascertain the validity of these amounts because of the mode of harvesting (bananas mature at different times). It was also not possible to establish the actual average households' needs because the crop is normally regarded as substitute food especially when maize shortage is experienced.

Sorghum was not very popular food crop as only 17.2% of the households cultivated the crop. Sorghum is considered a crop for regions of inadequate rainfall, its production is confined mainly to the western side of Mosocho division. Finger millet was grown by a small number

(6.7%) of households on field sizes ranging between 0.01-1.00 acres with a negligible average. Finger millet, although a significant traditional food, is not popular because it requires a lot of labour during weeding because it is normally done by hand and most households avoid growing it.

Potatoes are also grown in the area. Sweet potatoes are a critical source of food in times of food shortages, but only a few households (17.2%) grew them on very small field sizes due to population pressure. Irish potatoes are not popular because apart from their low yields, they require high investment in form of seeds, fertilizer and pesticides.

Household food production is a significant contributor to food security especially among small scale farmers. Analysis of the food crop land use showed that maize was the main food crop as it was allocated fairly larger field sizes (0.63 acres) compared to other food crops. Maize is a primary stable food in the study area and its availability and abundance determines the level of food security at the household level. In Kenya, maize is estimated to account for 20% of the agricultural production and contributes 68% of daily per capita cereal consumption apart from providing 25% of agricultural employment (Shroeder *et al.*, 2013). Production of maize is therefore strongly linked to national food security. Maize production in the study area is low, an indication of household food insecurity. Other food crops were also associated with low acreage and production levels.

#### 4.4.2 Cash Crops

Among the cash crops grown in the study area, tea was the most prevalent and was grown by 60.3% of the households followed by coffee (32.1%) and then sugarcane (24.4%) as shown in Table 4.11b. Tea is grown in all parts, though on small field sizes which ranged between 0.05-2.00 acres with an average of 0.37 acres.

**Table 4.11b: Cash Crop Production** 

Сгор	Frequency	% of farmers	Field size (acres)	Mean field size	Ave. prod per household/year
Tea	126	60.3	0.05-2.00	0.37	1,600 Kg
Coffee	67	32.1	0.05-1.13	0.50	217 Kg
Sugarcane	51	24.4	0.01-5.00	0.18	-

Source: Research Data, 2012

Small-sized farms can be uneconomical for production of certain crops. For example, small scale tea farmers in Kenya on average utilize about 0.27 ha. (0.67 acres) of their farms for tea but in the study area, the average field size for tea was much lower (0.37 acres). Studies have shown that tea field sizes of less than 0.25 acres (0.10 ha) are uneconomical (Kavoi *et al.*, 2002). Given that tea field sizes in the study area ranged between 0.05-2.00 acres, this means that probably a large number of farmers were operating uneconomical sizes.

The average quantity of green leaf produced was 1,600 Kg per household per annum and despite its low acreage, tea was considered as an important source of income and identified as the most profitable farm enterprise. The study area has ideal climatic and soil conditions for tea production. The agronomic and marketing aspects of its production are also fairly well managed by the Kenya Tea Development Agency (KTDA).

Coffee was grown by 32.1% of sample households on small field sizes ranging from 0.05-1.13 acres with a mean of 0.5 acres. According to Karanja and Nyoro (2002), a coffee farm of a half an acre with approximately 500 coffee trees is uneconomical because its gross margins cannot be enough to buy enough food for a family. Coffee cultivation has generally declined in the study area due to the low prices and the inefficiencies in the marketing systems over the years. It is now predominantly grown in the northern region of the study area. Out of the households that reported allocating land to coffee, only 30% reported having harvested the crop in the previous 12 months, partly because the crop had been pruned. Overall, coffee growing was considered one of the least profitable enterprises by the households.

Sugarcane was grown by 24.4% of the sample households. The crop is cultivated mainly in the lower areas of Mosocho division where it is grown for chewing and commercial sugar production. It was grown on land sizes ranging between 0.01 and 5.00 acres with an average land size of 0.18 acres (Table 4.11b). About 20% of the farmers reported harvesting cane ranging between 2 and 30 MT per annum. Sugarcane for chewing is sold in urban areas such as Kisumu, Nakuru and Nairobi, as well as on periodic markets in the study area. Sugarcane is an important source of income, about 10% of the household heads ranked it as the most profitable enterprise.

## 4.4.3 Fruits and Vegetables

A variety of fruits were grown in the study area, 38.8% of the households grew fruits such as avocadoes, pawpaws, pineapples, mangoes and passion fruits among others. It was not

possible to collect data on the amount of land devoted predominantly for fruit production. This is mainly attributed to some of the fruits being grown along the hedges and also in the residential area. However, most farmers recorded land sizes of between 0.01 and 0.6 acres for crops like pineapples. Among the fruits grown, avocadoes were found to have a fairly organized marketing system with traders visiting farms and buying directly from farmers. Farmers cultivating avocado fruit indicated that the harvest ranges between 1 and 480 bags, with an average yield of about 16.7 bags per household per annum.

Vegetables were grown by most households (76.6%) although on small land sizes averaging 0.16 acres. The main vegetables grown were; kales, tomatoes, cabbages, onions, carrots and local traditional ones. Vegetables are grown both for domestic consumption and for sale.

The allocation of small land sizes for the cultivation of fruits and vegetables is due to the fact that for most farmers, these crops are considered supplementary to the production of main crops (food and cash crops). According to Tufa *et al.*, (2014), low priority given to horticultural crops cultivation is mainly due to the traditional food consumption habits that favour grain crops and livestock products.

# **4.4.4 Pasture and Napier Grass**

Napier grass was a popular crop grown by 91.4% of the households on land sizes ranging between 0.01 and 4.63 acres; with an average land size of 0.35 acres. Napier grass for sale was measured using wheelbarrows and households reported an average production of 490 wheelbarrows per household per annum during the study period. A wheelbarrow full of napier grass was sold for Kshs 200. The crop was ranked as the second most popular, after maize.

In the study area, 89.5% of the sample households kept livestock and the amount of land devoted to pasture (livestock keeping) was generally less than one acre as reported by 76.6% of the households. About 58.3% of the households with dairy animals produced milk whose quantity ranged between 60 litres to 19,200 litres per annum. Majority of the respondents (81%) produced less than 1,000 litres of milk per year with an average of about 770 litres per household per year. This amount was considered enough for most households as their average daily consumption was about 1.3 litres. Most fresh milk was sold to neighbours and was an important source of income that was used for purchase of food among other household items.

In conclusion, agricultural land was allocated among different land uses as follows; food crop production took the largest share ( $\approx$ 65%) followed by cash crops ( $\approx$ 25%) and the rest of the land uses shared the remaining farm land. These findings are in agreement with those of Conelly and Chaiken (2000) who found that typical small scale farming households in Kenya devote 10-25% of their land to cash crops and the remaining portion to the food crops such as maize, beans and potatotes. Maize was the most important crop in terms of the number of households who had allocated land to its production (98%), followed by napier grass (91.4%), beans (87.1%), bananas (77.0%), vegetables (76.6%), tea (60.3%), fruits (38.8%), coffee (32.1%), sugarcane (24.4%), potatoes and sorghum (17.2%) and finally finger millet (6.7%). This study clearly showed that households utilized most of their farms to produce food crops, an indication of their need to be food secure. The agricultural activities discussed above are important sources of livelihoods and determine, to a large extent, whether households get access to adequate food or not.

# 4.5 Assessment of Household Food Security Situation in the Study Area

This section examines the second objective of the study which was to assess the food security situation of households in the study area. This objective was realized by assessing the households' food security situation for a period of 12 months prior to the study, causes of reported food shortages and ways of coping with the shortages.

#### **4.5.1 Household Food Security Situation**

Heads of households were asked to state whether they had access to enough food throughout the previous year either through their own production, purchase or other sources. They were also asked to indicate periods when they experienced shortages. Households responded variously; 18.7% reported that they had adequate food, 58.8% experienced food shortage for a period of 1-2 months which they considered mild, 19.6% experienced food shortage for 3-5 months and 2.9% had severe shortage (more than 6 months of the year). This study considered households with adequate food and those with mild shortage as being food secure because households which face mild food shortage just before the next harvest are able to cope by early harvesting, skipping of one meal or so but for short periods which may not affect their health. On the other hand, households which experienced food shortage for a period of three months and more were considered food insecure as they would have a difficult time in coping with such shortages. Table 4.12 presents a summary of the households' food security situation.

Table 4.12: Food Security Situation among Sample Households in the Study Area

Househo	ld Food security situation	Frequencies	Percentage (%)
Food secure	Adequate food	39	18.7
	Mild shortage (1-2 months)	123	$   \begin{array}{c}     18.7 \\     58.8   \end{array}   \right}   77.5\% $
Food insecure	Shortage (3-5 months)	41	$\left. \begin{array}{c} 19.6 \\ 2.9 \end{array} \right\} \ \ 22.5\%$
	Severe shortage (> 6 months)	6	2.9
	Totals	209	100

Source: Research Data, 2012

The household food security situation in the study area is as follows: 77.5% are food secure and only 22.5% of the households are food insecure (Table 4.12). These results are not surprising given the fact that Kisii Central sub-County is endowed with good climatic conditions suitable for different agricultural activities that can boost food security. This explanation concurs with Mbidha's (2011) who says that household food security varies from one region to another and that food availability is affected by the geographical location of the area as well as household socio-economic characteristics, physical and environmental factors. Other researchers on this subject present various food security status; Kabui (2012) found that 44.7% of the households in Tharaka Central division, a semi-arid region, were food insecure, 43.3% were vulnerable to food insecurity and only 12% were secure. On the other hand, Kaloi *et al.* (2005) found that 62% of the households in Mwingi district, Kenya were food secure while 38% were not.

#### **4.5.2** Causes of Food Shortages among Households

Respondents in this study were asked to identify the main causes of food shortages in their households. Seven causes were identified among them low crop yields, scarcity of land and drought. Table 4.13 summarizes these responses.

Table 4.13: Causes of Food Shortages among Households

Causes	Frequencies	Percentage
Scarcity of land	80	38.3
Low yields	41	19.6
Drought	28	13.4
Soil exhaustion	24	11.5
High population	17	8.1
Poor crop varieties	10	4.8
Others (high food prices, poverty)	9	4.3
Totals	209	100

Source: Research Data, 2012

According to respondents food shortages are mainly caused by scarcity of land (38.3%), low agricultural productivity captured by issues of low yields (19.6%), soil exhaustion (11.5%) and poor crop varieties (4.8%). Drought interpreted to mean late onset of rainfall was considered an important cause by 13.4% of the sample and others were high population, poor crop yields, high food prices and poverty. These findings are in line with those of Mbidha's (2011) study in Turkana who argues that the common underlying causes of food insecurity in Kenya at all levels relate to drought, crop failure, diminishing resource base, limited access to productive resources and civil strife.

#### **4.5.3** Coping with Food Shortages among Households

Coping strategies are strategically selected acts that individuals and households in a poor socio-economic position use to restrict their expense or earn some extra income to enable them pay for basic necessities such as food (Mjonono *et al.*, 2009). Strategies can be divided into "coping strategies" to deal with short term insufficiency of food and "adaptive strategies" which are long term changes in the way households and individuals acquire sufficient food or income (Davis, 1993). Davis (1993) further distinguishes between "income soothing" and "consumption soothing strategies". Income soothing strategies attempt to reduce food insecurity through income diversification and consumption soothing strategies attempt to limit consumption of members of a household. A number of household level strategies for dealing with insufficient

food have been identified by other researchers which include: short term dietary changes; reducing or rationing consumption; altering household consumption; altering intra-household distribution of food; increased use of credit; increased reliance of wild food; alteration of crops and livestock production patterns; and sales of assets (Davis, 1993; Frankenberg, 1992; Corbett, 1988).

Respondents who indicated that they faced food shortages were asked to explain how they coped with the situation. Most of them (78%) reported that they purchased the food they required, 17.5% worked in neighbours farms and were paid using food instead of money, while only a few received the food as gifts from friends and neighbours (Table 4.14). This shows that

**Table 4.14: Ways of Coping with Food Shortages** 

Coping Mechanism	Frequencies	Percentage	
Buying of food	163	78.0	
Working for food	37	17.5	
Gifts	5	2.5	
Buying and gifts	4	2.0	
Totals	209	100	

Source: Research Data, 2012

most households did not produce enough food on their farms but depended on the market for their food needs. Households without adequate income were therefore at risk of food shortages. When respondents were asked to comment on the prices of food, over 93% of them stated that the food prices were high while 6% said they were reasonable. According to Lugairi (2011), the effectiveness of the adopted coping strategies will vary depending on the households' level of poverty. For example, households facing high poverty will experience challenges in affording the high food prices charged during times of food scarcity.

The coping strategies adopted by households in the study area are short term and unsustainable. Reliance on food purchases as a coping strategy for most households is not sustainable given the high level of poverty and food poverty in the study area. This implies that households may not be able to access food if faced with long periods of shortages because their incomes are generally low. Working for food as a coping strategy does not also guarantee food

accessibility given that most (68.4%) of the households own less than the average farm size of 2.08 acres. Results of a study by Regassa (2011) on smallholder farmers coping strategies in Southern Ethiopia showed a negative but significant relationship between land size and the number of coping strategies. It was found that an increase in one unit of land size results in a decrease in the number of coping strategies by 0.489 units. There was also a significant relationship between household size and the number of coping strategies which implied that the larger the household size the more the number of coping strategies (Ibid). Kabui (2012) also found that the most important coping strategies among small scale farmers in Tharaka Central Division of Kenya were reduction in sizes of meals and consumption of immature crops.

Studies in developing countries have also documented that households employ a range of coping strategies during sustained food insecurity and hunger namely: choice of cropping patterns to spread risks involving mixed cropping, cultivation of secondary crops, off-farm income earning, migration changes in consumption patterns, mutual support patterns (Richard, 2009; Arun, 2006). Due to varying degrees of wealth among households, different coping strategies are adopted by households at different poverty levels. However, some coping strategies are common to all households although the extent to which such strategies enable a household to remain afloat depend on the assets at their disposal (Devereux, 2001). Faced with income or food shock, households may either protect their food consumption by purchasing or receiving food from other sources (Davis, 1993).

In conclusion, assessment of the food security status of households in the study area indicates that most households are food secure (77.5%) while 22.5% experience food shortages of three months or more within a year. Scarcity of land which implies small farm sizes and low yields are the two most prevalent causes of food shortages among households. Households who are unable to produce enough food mainly purchase it or work for it.

# 4.6 The Relationship between Agricultural Land Use and Household Food Security Situation

This section discusses the third objective of this study which was to establish the relationship between agricultural land use and household food security situation. It is the contention of this study that the way households utilize their farms has a direct impact on their food security situation and largely determines whether they are food secure or not. The research

question addressed in this section was "how does agricultural land use affect household food security in the study area?" In order to answer this question, different agricultural land uses and their effect on household food security was tested. The chi-square test was used to test the relationship between cash crop, food crop, fruits and vegetables, pasture and napier grass land uses and household food security situation at p=0.05 level of confidence. The following is a discussion of these relationships.

# 4.6.1 Cash Crop and Household Food Security Situation

The relationship between cash crop land use and household food security was tested and results are presented in Table 4.15. Results show that there was some relationship between cash crop farming (as a land use) and household food security situation. For example, out of 162 households who were engaged in cash crop farming, a large proportion (72.2%) were food secure. Similarly, of the 47 households who were not engaged in cash crop farming, majority (55.3%) were found to be food insecure.

Table 4.15: Cash Crop and Household Food Security Situation

			Whether cultivates cash crop		
			No	Yes	Total
Household food	Food	Count	26	45	71
security situation	insecure	%	55.3%	27.8%	34.0%
	Food	Count	21	117	138
	secure	%	44.7%	72.2%	66.0%
Total			47	162	209
$\gamma^2 = 12.319$	df = 1	p = 0.00	Phi Coefficient ( $\phi$ ) = 0.243		

These findings suggest that engaging in cash crop farming can improve significantly households' food security situation. This was confirmed and supported by a high chi-square value of 12.319 at a significance level of p=0.00. This suggests that cash crop farming (land use) had a significant effect on household food security situation implying that growing of cash crops improved the chances of households being food secure. Similarly, Phi Coefficient ( $\phi$ ) of 0.243 supports these findings indicating a weak significant relationship between the two variables.

The results are in line with Langat *et al.* (2011) who found that land allocation to tea in Nandi South district positively and significantly influenced household food security. The results also compare favourably with the findings of a study by Govereh and Jayne (1999) carried out in Zimbabwe which showed that cotton commercialization at household level significantly and positively affected food production leading to food security. In addition, Capaldo *et al.* (2010) also found that the share of income from farm sales had a significantly positive impact on food consumption in Nicaragua suggesting that households that earn part of their livelihood from marketing their agricultural produce are less vulnerable to becoming food insecure. However, a study by Ndungu (2013) in Belgut division, Kenya found that the introduction of sugarcane had led to a decline in the amount of land allocated to food crop and this had led to high levels of food insecurity in the area. He argues that food purchases are low because of low unpredictable incomes accruing to sugarcane farmers. Sorre (2011) also found that sugarcane production competes with food production and results in a decline in food production. This has in turn resulted to problems of malnutrition in Nambale division of Busia district.

Studies have shown that cash crop production can increase food security by increasing food availability either through household production or by increasing the income available to purchase food (Achterbosch *et al.*, 2014; Schneider and Gugerty, 2010; Poulton *et al.*, 2006). Strasberg *et al.*(1999) argue that crop commercialization can contribute to food crop productivity in three ways; cash income from commercial production can overcome credit constraints that prevent households from purchasing fertilizer and other inputs, participation in a resource providing scheme provides access to inputs through the marketing firm that can be used in part on food crops and finally, cash income allows households to invest in assets such as tractors or draught animals that can increase productivity across crops. A study by Govereh *et al.* (1999) on the contribution of crop commercialization to food crop productivity among cotton growers in Mozambique and sugarcane growers in Kenya found that commercialization schemes increased access to improved seed, fertilizer, herbicides and pesticides in the two countries. In theory, farmers might be better off if they could produce only cash crops and use the earned income to purchase food, however, rural farming households perceive this to be a risk livelihood strategy according to Lukanu *et al.* (2004) study in Mozambique among smallholders.

# 4.6.2 Food Crop and Household Food Security Situation

The relationship between food crop growing (as a land use) and household food security was tested and the results showed that 66.5% of the households who grew food crops were food secure while 33.5% were not as shown in Table 4.16.

**Table 4.16: Food Crop and Household Food Security Situation** 

			Whether cultivates food crop			
			No	Yes	Total	
Household food	Food	Count	2	69	71	
security situation	insecure	%	66.7%	33.5%	34.0%	
	Food	Count	1	137	138	
	secure	%	33.3%	66.5%	66.0%	
Total			3	206	209	
$\chi^2 = 1.451$	df = 1	p = 0.228				

Although it seems that households that cultivated food crops were more likely to be food secure, this relationship, however, was found to be insignificant at p=0.228. This meant that food crop land use did not have a significant effect on household food security implying that

confirm those by Kuwornu *et al.* (2011) which showed that growing of food crops is not a guarantee of household food security as the two are not significantly related. Their study on the food security status of farming households in Central Ghana found that the majority (68.8%) of food crop producers were food insecure. However, Babatunde *et al.* (2007) found that food from

household food security was not determined by household food production. These findings

own production had a low but positive coefficient that was significant at 5% with household food

security status of rural farming households in North Central Nigeria. The implication was that the higher the amount of food from own production the higher the likelihood of food security.

There is evidence that households prefer to produce food crops even when the returns are higher from market oriented production and this is due to uncertainty about food prices in the local

markets, unfavourable price trends or unknown technology associated with production of commercial crops (Schneider and Gugerty, 2010). These findings imply that mere allocation of

land to food crop production is not a guarantee of food availability at the household level and

that food production can be improved without necessarily increasing allocation of land to its

production especially if productivity is enhanced by use of adequate quantities of fertilizers, pesticides and adoption of high breed seeds among other technologies.

## 4.6.3 Fruits and Vegetable Production and Household Food Security Situation

In order to establish the relationship between fruits and vegetable (land use) and household food security situation, a cross-tabulation of the two variables was done and results showed that the majority of the households who cultivated fruits and vegetables were food secure (65.0%) while 35.0% were food insecure (Table 4.17).

Table 4.17: Fruits and Vegetables and Household Food Security Situation

			Whether cultivate any fruits or vegetables		
			No	Yes	Total
Household food	Food	Count	2	69	71
security situation	insecure	%	16.7%	35.0%	34.0%
	Food secure	Count	10	128	138
		%	83.3%	65.0%	66.0%
Total			12	197	209
$v^2 = 1.700$	df – 1	n- 0 192			

 $\chi^2 = 1.700$ dt = 1p = 0.192

The relationship between fruits and vegetable production and household food security was found to be insignificant at p=0.192 confidence level. This suggests that fruits and vegetable production did not have a significant influence on household food security situation. These findings corroborate those of Kuwornu et al. (2011) which showed no significant relationship between vegetable farming and household food security in the Central Region of Joshi et al. (2006), on the other hand, studied the impact of diversification on Ghana. smallholders and found that the viability of small farms can be improved through production of higher-value crops like fruits and vegetables. Their results showed that vegetable production is more profitable and could augument income of small scale farmers and generate employment opportunities. Nuget (2000) also stresses that full time production of vegetables and keeping of a few dairy cattle in the slum areas in urban areas can produce an income 30% greater than an average salary. In addition, he found out that families engaged in these activities had a higher standard of living than those of neighboring non-farming families. The reason why fruits and

vegetables were found to be insignificantly related to household food security in study area could be due to the fact that these crops are allocated with very little land (given the low farm sizes) resulting in low production therefore, the income generated from their sales does not form an important source of money for the purchase of food. A study by Tufa *et al.* (2014) on determinants of smallholder commercialization of horticultural crops in Ethiopia revealed that farm size had a positive and significant influence on farmers' likelihood to participate in horticultural crops market.

# 4.6.4 Pasture and Napier Grass Growing and Household Food Security Situation

The relationship between pasture and napier grass (land use) and household food security situation was also tested and the results shown in Table 4.18. A large number of households (91.4%) had adopted this type of land use and the majority of them (69.1%) were found to be food secure and 30.9% were food insecure.

The results of the analysis show that a significant relationship was established at a confidence level of p=0.002 implying that growing pasture and napier grass had a significant impact on the food security situation of households in the study area. The Phi Coefficient ( $\phi$ ) of 0.212 also supported these findings although indicating that the relationship between the two variables was weak. This is a confirmation that growing of napier grass and keeping of livestock had a positive and significant influence on household food security situation.

Table 4.18: Pasture/Napier Grass and Household Food Security Situation

			Do you grow pasture/napier grass		
			No	Yes	Total
Household food	Food	Count	12	59	71
security situation	insecure	%	66.7%	30.9%	34.0%
	Food	Count	6	132	138
	secure	%	33.3%	69.1%	66.0%
Total			18	191	209

 $\chi^2 = 9.387$  df = 1 p = 0.002 Phi Coefficient ( $\phi$ ) = 0.212

These results also imply that it is possible to optimize livestock production on a small piece of land (especially under zero-grazing system) which can make a huge contribution to household income. Napier grass is a popular crop which is grown for sale by a large number of households even those without livestock. Napier grass has a ready market and can be grown several times a year on the same piece of land making it always available for sale. Moreover, napier grass may not require a lot of land because it is grown along the hedges and is also used in controlling soil erosion. These findings are consistent with those of Khan and Gill (2009) who found that food availability in the rural areas of Pakistan was significantly associated with increased production of crops and livestock products. Kidane *et al.* (2005) also found that livestock ownership was significantly related to household food security in Ethiopia and that this relationship was positive. In their study on livestock ownership and rural household food security in Pakistan, Ali and Khan (2013) found that households that owned livestock had higher levels (21%) of food security compared to those who did not have. This is because crop and livestock complement each other in ensuring household food security.

In conclusion, the research question on how agricultural land use affects household food security situation in the study area has been answered as follows; cash crop (p = 0.00) and pasture and napier grass (p = 0.002) were found to be significantly related to household food security. This implies that the two land use types had a close association with household food security and therefore their adoption in the farming system boosts household food security. The other two land uses that is; food crops and fruits and vegetables were not significantly related to household food security as their confidence levels were p=0.22 and p=0.19 respectively. The reason may be that production of fruits was negligible and their contribution to household income was low (contributes 14.4% to household income). The finding that food crop production was not significantly related to household food security was rather surprising given the large proportion of farms allocated to its production although not unexpected given that less than 20% of the household reported having adequate food. The explanation for this anomaly may be due to the fact that yields of most food crops are low and may not provide adequate food supplies for households. Moreover, some households are forced to sell some of their food to earn income in order to purchase non-food items. Subsequently there may be a reduction of the amount of food available for subsistence.

# 4.7 The Influence of Socio-economic Characteristics on Agricultural Land Use and Household Food Security Situation

The fourth objective of the study was to examine the influence of household socio-economic characteristics on agricultural land use activities and household food security. Household socio-economic characteristics influence decision making at the farm level and determine the manner in which agricultural activities are carried out and the livelihood systems adopted to ensure food security. The household characteristics which were found to have a significant influence on agricultural land use and household food security from the literature review were; gender, level of education of the household head, household size, farm size and household income level. The main research question was "how do the household socio-economic characteristics influence agricultural land use and household food security in the study area?" The following is a discussion on the influence of individual socio-economic characteristics on household food security and agricultural land use based on Chi-square analysis.

#### 4.7.1 Gender, Agricultural Land Use and Household Food Security Situation

The gender of the household head is an important factor in agriculture because it determines allocation of roles in households. Gender also determines access to, and control over property which is a significant indicator of household food security. The following is a discussion of the influence of gender on the four agricultural land uses and household food security situation.

# 4.7.1.1 Impact of Gender on Cash Crop and Household Food Security Situation

Results show a variation across gender in terms of cash crop growing. While 85.2% of the male headed households grew cash crops and slightly smaller percentage of female headed households (61.5%) were also found to be engaged in cash crop farming. In order to study the relationship among the three variables; household food security situation, gender and cash crop farming, frequencies from these variables were cross-tabulated (Table 4.19).

Table 4.19: Gender, Cash Crop and Household Food Security Situation

When	ther cultivates cash cro	ор	Gender of	Gender of the household		
				Male	Female	
No	Household food	Food	Count	16	10	26
	security situation	insecure	%	50.0%	66.7%	55.3%
		Food	Count	16	5	21
		secure	%	50.0%	33.3%	44.7%
	Total		Count	32	15	47
Yes	Household food	Food	Count	37	8	45
	security situation	insecure	%	26.8%	33.3%	27.8%
		Food	Count	101	16	117
		secure	%	73.2%	66.7%	72.2%
	Total		Count	138	24	162

From Table 4.19, it is evident that a large proportion of male headed households (73.2%) which cultivated cash crops were food secure and only 26.8% were food insecure. On the other hand, 66.7% of female headed households involved in cash crop production were food secure. Although from the analysis, male headed households seemed to be better off in terms of food security, the chi-square test showed no significant relationships among the three variables (p=0.510). Therefore the gender of the household head had no influence on cash crop growing and household food security meaning that there was no significant variation in cash crop growing among the genders. These results contradict those of Doss, 2001, which showed that in regard to the types of crops grown by households, women are more involved in food crops while men are involved in cash crops (whether food or non-food).

Results from various studies on gender and household food security are however conflicting. For example, Babatunde *et al.* (2008) conducted a gender-based analysis of vulnerability to food security in Nigeria and found that female headed households were more vulnerable to food insecurity than male headed households. Langat *et al.* (2011) also found that gender significantly influences household food security in Nandi South District of Kenya. In

a - for those with no cash crops

b - for those with cash crops

contrast Mallick and Rafi (2010) found no significant differences in the food security situation between male headed and female headed households among the indigenous ethnic groups in Bangladesh. In addition, Kuwornu, *et al.* (2011) also found no significant relationship between gender and food security status of farming households in the Central Region of Ghana.

## 4.7.1.2 Impact of Gender on Food Crop and Household Food Security Situation

The analysis of the influence of gender on food crop production and household food security was tested and results are shown in Table 4.20.

Table 4.20: Gender, Food Crop and Household Food Security Situation

Whet	ther cultivates			Gender o	of the respondents	
food	crops			Male	Female	Total
No	Household	Food insecure	Count	2		2
	food security		%	66.7%		66.7%
	situation	Food secure	Count	1		1
			%	33.3%		33.3%
	Total		Count	3		3
Yes	Household	Food insecure	Count	51	18	69
	food security		%	30.5%	46.2%	33.5%
	situation	Food secure	Count	116	21	137
			%	69.5%	53.8%	66.5%
	Total		Count	167	39	206

 $<sup>\</sup>chi^2 = a^2$  (No statistics were computed because of low cell frequencies)

$$\chi^2 = 3.461^b$$

$$df = 1$$

$$p = 0.063$$

**Note**: When there are empty cells in the cross-tabulation the calculation of the degrees of freedom changes to df=(r-1)(c-1)-k(no. of empty cells)

A large proportion of male headed households (69.5%) who cultivated food crops were food secure compared to 53.8% of their female counterparts. This suggests that female headed households who did not grow food crops were likely to suffer from food shortages compared to male headed households. This relationship was, however, found to be insignificant at p=0.063 which meant that gender did not have a significant influence on household food security situation

a - for those with no food crops

b - for those with food crops

nor did it influence the allocation of farm land to food crop production. Gender did not have a significant impact on household food security and food crop production probably because food production is practiced by all irrespective of the gender, for instance, nearly all households grew food crops and therefore, there was no marked variation among households that would bring about statistically significant differences.

These results compare favourably with Sekhampu (2013) in a study based in South Africa whose findings were that gender is not a significant indicator of food security situation at household level. Omonona and Agoi (2007), however, found that food insecurity was higher among female headed households in Lagos State, Nigeria.

### 4.7.1.3 Impact of Gender on Fruit and Vegetable and Household Food Security Situation

To analyze the impact gender had on the food security situation of households that had fruits and vegetables as a land use, a cross-tabulation of the three variables was done and the chi-square results are presented in Table 4.21. Most frequencies for male and female respondents without fruits and vegetables were below the required cell frequencies of 5 therefore, calculation of their impact was constrained. Most of the male headed households (76.1%) who cultivated fruits or vegetables had most of their households (67.1%) food secure and only 32.9% food insecure. On the other hand, 55.6% female headed households were food secure while 44.4% were food insecure. Although male headed households tended to be more food secure compared to female headed ones, this relationship was found to be insignificant at p=0.190. This implies that gender did not have a significant impact on the food security of households that produced fruits and vegetables probably because of little variation in food security and cultivation of fruits and vegetables between genders.

There are five assets that rural households depend on for survival and which affect agricultural production. They include financial, physical, social and human capital/assets. The extent to which household members are entitled to or lay claim to these assets depends on various factors including their position in the household and gender (Mikalista, 2010). The problems that face women farmers are more distinct due to socio-cultural constraints that affect their access to and control over essential assets necessary for improving their livelihoods and those of their households (Ibid).

Table 4.21: Gender, Fruits and Vegetables and Household Food Security Situation

	ther cultivate and vegetables				er of the ondents	Total
				Male	Female	<del>_</del>
No	Household food	Food	Count	0	2	2
	security situation	insecure	%	.0%	66.7%	16.7%
		Food secure	Count	9	1	10
			%	100.0%	33.3%	83.3%
	Total		Count	9	3	12
Yes	Household food	Food	Count	53	16	69
	security situation	insecure	%	32.9%	44.4%	35.0%
		Food secure	Count	108	20	128
			%	67.1%	55.6%	65.0%
	Total		Count	161	36	197

Studies such as those of Aidoo *et al.* (2013) and Sekhampu (2013) found gender to be insignificantly associated with household food security while others like Langat *et al.* (2011) and Kassie *et al.*(2014) found gender to influence food security and that female headed households were less food secure compared to male headed ones among Kenyan households. Although the above literature gives conflicting results, women play a predominant role in household food security through participating in agricultural and food production (FAO, 2009, 1997; UN, 1997). The insignificance of the gender influence on fruits and vegetable production and household food security may be probably because the study mainly focused on agricultural land use which may not have had a significant variation between male and female headed households.

## 4.7.1.4 Impact of Gender on Pasture and Napier Grass and Household Food Security

The impact of gender on pasture and napier grass (land use) and household food security was tested and the results from the analysis indicate that 72.4% of the male headed households who had pasture and napier grass as a land use were food secure while 27.3% were not (Table 4.22).

a - for those with no fruits/vegetables

b - for those with fruits/vegetables

Table 4.22: Gender, Pasture /Napier and Household Food Security Situation

Whet	her cultivates			Gender of	the respondents	Total
pastu	re/Napier grass			Male	Female	_
No	Household food	Food	Count	10	2	12
	security situation	insecure	%	71.4%	50.0%	66.7%
		Food secure	Count	4	2	6
			%	28.6%	50.0%	33.3%
	Total		Count	14	4	18
Yes	Household food	Food	Count	43	16	59
	security situation	insecure	%	27.6%	45.7%	30.9%
		Food secure	Count	113	19	132
			%	72.4%	54.3%	69.1%
	Total		Count	156	35	191

$$\chi^2 = 0.643^{a}$$
 df = 1  $p = 0.423$   
 $\chi^2 = 4.411^{b}$  df = 1  $p = 0.036$  Phi Coefficient ( $\phi$ ) = 0.152

Female headed households on the other hand, had a lower proportion of food secure household (54.3%). These figures show great variation between male headed households and their female counterparts. The relationship among gender and household food security situation of households which had cultivated pasture and napier grass was found to be significant at p=0.036. In addition, the Phi Coefficient (p=0.152) supported these findings but also indicated that the relationship among the three variables was weak. Unequal rights and obligations within households and societies impose restrictions on women's time use and availability which can undermine their efficiency and productivity due to multiple responsibilities and time conflicts (Quisumbing, 1994). Male headed households are associated with higher food security status compared to the female headed households because livestock ownership is largely a male enterprise therefore male headed households are able to generate more income from livestock products that can be used to purchase food.

The livestock sector is extremely important to the livelihood of households in developing countries and World Bank (2008) estimated that about 58% of the population of sub-Saharan Africa dependent on varying degrees on livestock. However, Esenu (2005) found that cattle

a - for those with no pasture/napier

b - for those with pasture/napier

ownership by women is a positive and significant contributor to food security. This is because women spend more of their income on food compared to men.

# 4.7.2 Level of Education of the Household Head, Agricultural Land Use and Household Food Security Situation

In this study, education level of the household head was considered to have an influence household food security. Educated people have the capacity to process and utilize the information passed to them about farm improvement. Lack of formal education or low education levels constraint access to employment opportunities and other means of getting livelihoods. The following section (4.7.2.1) presents results of the analysis of the influence of the level of education of household head on household food security and agricultural land use.

## 4.7.2.1 Level of Education of the Household Head, Cash Crop and Household Food Security Situation

The education levels of household heads were categorized into four groups namely; (1) those without formal education (none), (2) those who had attained primary, (3) secondary and finally, (4) post-secondary levels. When these categories were cross-tabulated with household food security situation and cash crop (land use) the following results were realized (Table 4.23).

All households that had not allocated land to cash crop production and whose heads had no formal education were food insecure according to the results of this study. On the other hand, 52% of the household heads who had attained primary education but had not cultivated cash crops were also food insecure. Also 38.5% of the households that did not have any cash crops but whose heads had attained secondary education level were equally food insecure. Post-secondary frequencies were however below the required number for statistical purposes, therefore, no meaningful relationships could be revealed. Although, food secure households seem to increase with the level of education, this relationship was however found to be insignificant at p=0.085. These results indicate that households that had not cultivated cash crops could not be food secure, even when the level of education of the household head was high.

Table 4.23: Education of the Household Head, Cash Crop and Food Security Situation

When	ther cultivates			Lev	el of educ	cation atta	ined	Total	
cash	crop			None	Pri.	Sec.	Post-		
							sec.		
No	Household food	Food	Count	6	13	5	2	26	
	security	insecure	%	100.0%	52.0%	38.5%	66.7%	55.3%	
	situation	Food	Count	0	12	8	1	21	
		secure	%	0%	48.0%	61.5%	33.3%	44.7%	
	Total			6	25	13	3	47	
Yes	Household	Food	Count	3	27	13	2	45	
	food security	insecure	%	50.0%	38.0%	18.6%	13.3%	27.8%	
	situation	Food	Count	3	44	57	13	117	
		secure	%	50.0%	62.0%	81.4%	86.7%	72.2%	
	Total			6	71	70	15	162	

 $\chi^2 = 6.609^a$  df = 3

 $\chi^2 = 9.713^b \qquad \qquad df = 3$ 

p = 0.085p = 0.021

Cramer's V = 0.245

Results also indicated that household heads with no formal education and who had grown cash crops were very few (3.7%). A majority of household heads (62.0%) with primary level of education and who had cultivated cash crops were food secure while 38.0% were food insecure (Table 4.23). For households with cash crops whose heads had attained secondary education, 81.4% were food secure and 18.6% were food insecure. With regard to household heads who had attained post-secondary education and were involved in cash crop production, 86.7% of their households were food secure. This relationship was found to be significant at p=0.021 which indicates that level of education of the household head had a positive and significant impact on the households' choice of cash crop as a land use and also food security. Similarly, Cramer's V of 0.245 supports the findings although indicating a low but significant relationship between the three variables. These results show that higher education combined with the decision to engage in cash crop production ultimately influences household food security status. This suggests that the more educated the heads of households are, the more aware they become about opportunities available to increase the value in land use which may involve production of cash crops. This

a - for those with no cash crops

b - for those with cash crops

could be because an educated person is able to absorb instructions or extension information and effectively utilize it to increase productivity which has a positive impact on household food security. There is evidence that educated farmers have a higher livelihood of investing in cash crops compared to illiterate ones and this is because educated farmers are better at managing risks associated with a shift from food to cash crop production (Cole *et al.*, 2014).

## 4.7.2.2 Level of Education of the Household Head, Food Crop and Household Food Security Situation

Analysis on the influence of the level of education of the household head on household food security and food crop (land use) showed that only 25.0% of those without formal education were food secure in spite of engaging in food production and those with primary, secondary and post-secondary levels of education were 58.5%, 78.3% and 82% respectively (Table 4.24).

Table 4.24: Education of the Household Head, Food Crop and Food Security Situation

	ther cultivate food crop			I	Level of Education of the household head				
J	1			none	pri.	sec.	post-sec.	<u> </u>	
No	Household food security	Food insecure	Count %		1 50.0%		1 100.0%	2 66.7%	
	situation	food secure	Count %		1 50.0%		0 0%	1 33.3%	
	Total				2		1	3	
Yes	Household food security	Food insecure	Count %	9 75.0%	39 41.5%	18 21.7%	3 17.6%	69 33.5%	
	situation	food secure	Count %	3 25.0%	55 58.5%	65 78.3%	14 82.4%	137 66.5%	
	Total			12	94	83	17	206	

$$\chi^2 = 0.750^a$$
 df = 1  $p = 0.386$   
 $\chi^2 = 19.089^b$  df = 3  $p = 0.000$  Cramer's V = 0.304

These findings indicate that household food security tended to improve with increase in the level of education for households engaged in food crop production. The Chi-square value for this relationship was very high (19.089) indicating a significant relationship (p= 0.000) among

a - for those with no food crops

b - for those with food crops

level of education, household food security and food crop production. Cramer's V of 0.304 also supports the findings indicating a significant relationship between the three variables. The implication of these findings is that education is important in agriculture because farmers with formal education are capable of utilizing skills and farm resources in a manner that will enable them to provide enough food for the family. These results in line with those of Asogwa and Umeh (2012) who found that the years of formal education of household heads were positively and significantly related to household food situation in Nigeria. Kaloi *et al.* (2005) also found that the education of the household head was significantly associated with food security in Mwingi district, Kenya and that the relationship was positive.

## 4.7.2.3 Level of Education of the Household Head, Fruits and Vegetable Cultivation and Food Security Situation

The influence of the level of education of the household head on household food security and fruits and vegetable growing (as a land use) was tested. An examination of those households who grew fruits and vegetables, their food security and levels of education indicate that where the heads had no formal education, the majority (72.7%) were food insecure and the proportion declined to 42.4%, for those with primary level of education and further reduced to 23.4% for those with secondary level (Table 4.25). This suggests that the food security situation improved in those households whose heads had higher levels of education and were cultivating fruits and vegetables. This relationship was found to be significant at p=0.002 implying that there was a significant relationship among the three variables. Similarly, Cramer's V of 0.273 supports the findings although indicating a significant relationship among variables. This could be because people with more formal education are able to utilize technologies that can improve fruit and vegetable in order to produce surpluses for sale. According to Bogale and Shimelis (2009), education equips individuals with necessary knowledge of how to make a living. Literate individuals are keen to get information and use it hence household heads with high education are more likely to benefit from agricultural technologies and thus become food secure.

Table 4.25: Education of the Household Head, Fruits/Vegetables and Food Security Situation

Wheth	ner cultivates			Level o	f Education	on of the	household	Total
fruits	and vegetable	es		head				
				None	pri.	sec.	post-sec.	•
No	Household	Food	Count	1	1	0	0	2
	food	insecure	%	100.0%	25.0%	.0%	.0%	16.7%
	security	food secure	Count	0	3	6	1	10
	situation		%	0%	75.0%	100.0%	100.0%	83.3%
	Total		Count	1	4	6	1	12
Yes	Household	Food	Count	8	39	18	4	69
	food	insecure	%	72.7%	42.4%	23.4%	23.5%	35.0%
	security	food secure	Count	3	53	59	13	128
	situation		%	27.3%	57.6%	76.6%	76.5%	65.0%
	Total		Count	11	92	77	17	197
$\chi^2 = 6$	$\chi^2 = 6.600^a$ df = 3		p = 0.	086				
$\chi^2 = 1$	$\chi^2 = 14.642^{b}$ df = 3		p=0.	002	Cramer's	V = 0.273		

a - for those with no fruits/vegetables

b - for those with fruits/vegetables

These findings are corroborate the results by Esturk and Oren (2014) who found that household heads who were university graduates were 5.6 times more likely to be food secure compared to "only literate" ones in Pakistan. This means that household heads with higher levels of education are likely to be receptive to and to be able to use extension services more effectively to increase productivity of their farm operations. As horticultural production requires technical knowledge about crop varieties, protection against pest and diseases, use of fertilizers and timely harvesting and marketing, farmers without formal education may not have the ability to engage effectively and profitably in growing of fruits and vegetables.

## 4.7.2.4 Level of Education of the Household Head, Pasture and Napier Grass and Food **Security Situation**

Pasture and napier grass growing was found to be popular with 91.4% of the respondents. Results show that 62.5% of the households whose heads had no formal education were food insecure compared to 37.5% who were food secure.

Table 4.26: Education of the Household Head, Pasture/Napier Grass and Food Security Situation

Whe	ther cultivates				Level of	Education		Total
past	ure and napier			none	pri.	sec.	post-	
grass	S						sec.	
No	Household	Food	Count	4	5	2	1	12
	food security	insecure	%	100.0%	71.4%	40.0%	50.0%	66.7%
	situation	Food	Count	0	2	3	1	6
		secure	%	0%	28.6%	60.0%	50.0%	33.3%
	Total			4	7	5	2	18
Yes	Household	Food	Count	5	35	16	3	59
	food security	insecure	%	62.5%	39.3%	20.5%	18.8%	30.9%
	situation	Food	Count	3	54	62	13	132
		secure	%	37.5%	60.7%	79.5%	81.3%	69.1%
	Total		8	89	78	16	191	
$\chi^2 = 1$	$\chi^2 = 3.921^a$ $df = 3$ $p = 0$ .		. 270					
$\chi^2 =$	$\chi^2 = 11.750^{\text{b}}$ df = 3 $p = 0$ .		. 0008	Cra	mer's V =	0.248		

a - for those with no pasture/napier

b - for those with pasture/napier

As shown in the Table 4.26, 60.7% of those with primary level education and who had pasture and napier grass were food secure while 39.3% were food insecure. The proportion of food secure household with pasture and napier grass increased from 78.5% for those with secondary level of education to a high 81.3% for those with post-secondary level of education. This suggests that there was a positive relationship between households' food security situation, levels of education of household heads and the growing of pasture and napier grass. This relationship was found to be significant at p=0.0008 which indicates that level of education had a significant influence on household food security and the cultivation of pasture and napier grass. The Cramer's V of 0.248 also indicates that a significant relationship existed among the variables.

This could be attributed to the fact that people with higher formal education are able to maximize production of livestock or napier grass to assist in buying food for their households. They may also be able to attract employment which may enable them to bring in more income to enhance their food security situation. These findings are in agreement with those by Khan and Gill (2009) that showed that food availability was significantly associated with increased

production of crops and livestock products. A study by Kassa *et al.* (2002) also found that households who own livestock have a good food security status because livestock products serve as assets that may provide a reserve that can be converted to cash in times of need.

#### 4.7.3 Household Size, Agricultural Land Use and Household Food Security Situation

The size of a household is regarded as an important indicator of household food security because it influences the demand for food and other household necessities. Households were categorized according to the number of people who live together and share meals. The first category was for households with 1 - 5 people, the second was for households with 6 - 10 people, third was those with 11 - 15 people and the fourth were those of over fifteen people (>15). The average household size in the area was 7.59.

#### 4.7.3.1 Household Size, Cash Crop and Household Food Security Situation

Analysis of the relationship among various household sizes, household food security situation and cash crop growing shows that 80.0% of the households who grew cash crops were food secure in households of 1-5 people, 71.2% for household sizes of 6 -10, 70.0% for 11-15 households size (Table 4.27). When household sizes were analyzed together, majority of those (72.2%) who grew cash crops were food secure compared to 27.8% of those who did not. This relationship, however, was not significant (p=0.331) as the low chi-square value of 3.42 indicates. The lack of significant relationship among the three variables could be due to the fact that, household size plays no role in decision making on whether to grow cash crops or not, or both small and large households engage in cash crop production.

Table 4.27: Household Size, Cash Crop and Household Food Security Situation

Whet	her cultivates				Household	size categor	ries	Total
cash o	crop			1-5	6-10	11-15	>15	_
No	Household	Food	Count	7	15	3	1	26
	food	insecure	%	53.8%	57.7%	42.9%	100.0%	55.3%
	security	Food	Count	6	11	4	0	21
	situation	secure	%	46.2%	42.3%	57.1%	.0%	44.7%
	Total			13	26	7	1	47
Yes	Household	Food	Count	7	30	6	2	45
	food	insecure	%	20.0%	28.8%	30.0%	66.7%	27.8%
	security	Food	Count	28	74	14	1	117
	situation	secure	%	80.0%	71.2%	70.0%	33.3%	72.2%
	Total			35	104	20	3	162

$$\chi^2 = 1.318^a$$
 $\chi^2 = 3.425^b$ 

df = 3

df = 3

These findings support those of Nyangweso *et al.* (2007) that it is not the household size that is significantly associated with household food security but rather the number of adults in a household. Sekhampu (2013) on the other hand, found out that household size is negatively associated with household food security situation. This takes cognizance of the fact that the number of people in a household, especially in situations where more household members are actively involved in off-farm income generating activities, may use their earnings to supplement household food needs. Alternatively, large households may constrain the ability of household to provide basic necessities including food. This is likely to render larger households food insecure.

#### 4.7.3.2 Household Size, Food Crop and Household Food Security Situation

The influence of household size on food crop and household food security was tested and results presented in Table 4.28. Results indicate that 70.8% of those whose household size was 1-5 were food secure and the proportion of food secure households declined to 65.9% for those with 6-10 people and increased to 68.0% for household size of 11-15 (Table 4.29). Although, the household food security situation appears to improve with a decline in household size for those who had cultivated food crops, this relationship was insignificant at p=0.315.

p= 0. 725

p= 0. 331

a - for those with no cash crops

b - for those with cash crops

Table 4.28: Household Size, Food Crop and Household Food Security Situation

Wheth	ner cultivates				Household	size catego	ories	Total
food c	rop			1-5	6-10	11-15	>15	<del></del>
No	Household	Food	Count		1	1		2
	food	insecure	%		100.0%	50.0%		66.7%
	security	Food	Count		0	1		1
	situation	secure	%		.0%	50.0%		33.3%
	Total				1	2		3
Yes	Household	Food	Count	14	44	8	3	69
	food	insecure	%	29.2%	34.1%	32.0%	75.0%	33.5%
	security	Food	Count	34	85	17	1	137
	situation	secure	%	70.8%	65.9%	68.0%	25.0%	66.5%
	Total			48	129	25	4	206

 $\chi^2 = 0.750^{a}$  df = 1 p = 0.386 $\chi^2 = 3.544^{b}$  df = 3 p = 0.315

a - for those with no food crops

<sub>b</sub> - for those with food crops

These findings may be as a result of the fact that, the mere allocation of land to food crops is not a guarantee of the amount of food production. Moreover, some of the food produced may be sold to raise income for other household needs and hence expose them to food insecurity, particularly in situations where households are large. The findings contradict those of Kaloi *et al.* (2005) who found that household size was significantly related to household food status and that as the household size increases, the status of food in the household declines. Omonona *et al.* (2007) also found that food insecurity increases with household size. Similarly Adebayo (2012) in his study in Osun State, Nigeria and Haile *et al.* (2005) in Oromiya Zone, Ethiopia found that large family size has a negative influence on household food security.

#### 4.7.3.3 Household Size, Fruits and Vegetable and Household Food Security Situation

The majority of the households in the sample (94.3%) cultivated fruits and vegetables on their farms. Results showed that 69.8% of the households with 1-5 people and who had cultivated fruits and vegetables were food secure. The proportion of food secure households was 64.5% and 65.4% for household sizes of 6-10 people and 11-15 people respectively (Table 4.29).

Table 4.29: Household Size, Fruits and Vegetables and Household Food Security Situation

Whet	her cultivates				Household	size categor	ries	Total
fruits	s or vegetables	S		1-5	6-10	11-15	>15	
No	Household	Food	Count	1	1	0		2
	food	insecure	%	20.0%	16.7%	.0%		16.7%
	security	Food	Count	4	5	1		10
	situation	secure	%	80.0%	83.3%	100.0%		83.3%
	Total			5	6	1		12
Yes	Household	Food	Count	13	44	9	3	69
	food	insecure	%	30.2%	35.5%	34.6%	75.0%	35.0%
	security	Food	Count	30	80	17	1	128
	situation	secure	%	69.8%	64.5%	65.4%	25.0%	65.0%
	Total			43	124	26	4	197
$v^2 - 0$	) 240a	df - 2	n-	- 0. 887				

 $\chi^2 = 0.240^8$ 

p= 0. 887

 $\chi^2 = 3.256^b$ 

df = 3 p = 0.354

a - for those with no fruits/vegetables

b - for those with fruits/vegetables

From Table 4.29, the chi-square test shows that household size does not significantly (p =0.354) influence the production of fruits and vegetable nor household food security. Perhaps the other reason why the impact of fruits and vegetables on household food security appears to be insignificant is that the contribution made by these crops to the household economic status is often underestimated. Another possible explanation could be that although vegetables contribute to the improvement of households' nutritional levels, they may not be regarded as food because households attach very high value to mainly maize and beans which are regarded as staple foods. These findings contradict those of Oluok (2006) who found that household size is one of the principal components determining the improvement of household food security in Nyando district, Kenya. Kuwornu et al. (2013) also found that in Ghana, households' dependency ratios were significantly associated with food security and that the relationships were inverse. However, Feleke et al. (2005) found no significant association between household food security and household size in Southern Ethiopia. This could be the reason why when household size, household food security and production of fruits and vegetables are analyzed together, the relationship is found to be insignificant.

#### 4.7.3.4 Household Size, Pasture / Napier Grass and Household Food Security Situation

Pasture and napier grass was a popular land use among households (Table 4.30).

Table 4.30: Household Size, Pasture / Napier Grass and Household Food Security Situation

Whet	her cultivates			Н	ousehold s	ize categori	ies	Total
pastu	re / napier grass	S		1-5	6-10	11-15	>15	
No	Household	Food	Count	6	4	2		12
	food	insecure	%	60.0%	66.7%	100.0%		66.7%
	security	Food	Count	4	2	0		6
	situation	secure	%	40.0%	33.3%	.0%		33.3%
	Total			10	6	2		18
Yes	Household	Food	Count	8	41	7	3	59
	food	insecure	%	21.1%	33.1%	28.0%	75.0%	30.9%
	security	Food	Count	30	83	18	1	132
	situation	secure	%	78.9%	66.9%	72.0%	25.0%	69.1%
	Total				124	25	4	191
$\chi^2 = 1$	$\chi^2 = 1.200^{a}$ df = 2 $p = 0$			). 549				

 $<sup>\</sup>chi^2 = 1.200^{a}$  df = 2 p = 0.549 $\chi^2 = 5.741^{b}$  df = 3 p = 0.125

Analysis of the data (Table 4.30) shows that households who had cultivated pasture and napier grass faced the following food security situations; 78.9% of the household size of 1-5 category were food secure, for category 6-10 the proportion of food secure households reduced to 66.9% and the majority (72.0%) of the households in category 11-15 were also food secure. Although household food security tended to decline with increase in household size, the trend was not consistent therefore the relationship was found to be insignificant at p=0.125. This implies that household food security, household size and pasture and napier grass were not significantly related. The reason could be due to the fact that household size has no impact on either household food security or the cultivation of pasture and napier grass. In this study the allocation of land to pasture and napier grass was an indication of livestock production and this variance from the expected contradicts studies such as (Mukoya -Wangia, 1999) which indicate that possession of livestock is positively associated with household food security. This is because livestock is meant to provide households with the necessary milk and other products and animals

a - for those with no pasture/napier

b - for those with ca pasture/napier

were also considered as assets that could be sold to purchase food during times of shortages. Perhaps the relationship among the three variables was insignificant due to the fact that most cells in the cross-tabulation especially those related to households of over fifteen people had no frequencies.

#### 4.7.4 Farm Size, Agricultural Land Use and Household Food Security Situation

Farm size was expected to be a significant indicator of agricultural land use and household food security situation because the amount of land accessible to households influences how they apportion it among different crops and other farm enterprises. It is normally expected that households with large farms are able to engage in cash crop and food crop production in contrast with cases where land is a constraint. These activities are expected to improve household food security. Data on farm sizes was divided into three categories. Households with less than one acre were grouped together and were found to constitute 20.1% of the sample, those with 1-2 acres were 48.3%, while 31.6% households had more than two acres. The following is a discussion of the relationship between household food security and farm size in relation to different land uses.

#### 4.7.4.1 Farm Size, Cash Crop and Household Food Security Situation

From the analysis it is evident that households who had not cultivated cash crops had the following results; 65% of those who owned less than one acre of land were food insecure, the proportion of food insecure households declined to 60.0% for those who owned 1-2 acres. Only 14.3% of those households with over 2 acres of land were food insecure (Table 4.31).

Table 4.31: Farm Size, Cash Crop and Household Food Security Situation

Whet	her cultivates			App	roximate fai	m size	Total
cash	cash crop				1-2 acre	> 2 acres	
No	Household food	Food	Count	13	12	1	26
	security situation	insecure	%	65.0%	60.0%	14.3%	55.3%
		Food	Count	7	8	6	21
		secure	%	35.0%	40.0%	85.7%	44.7%
	Total			20	20	7	47
Yes	Household food	Food	Count	9	24	12	45
	security situation	insecure	%	40.9%	29.6%	20.3%	27.8%
		Food	Count	13	57	47	117
		secure	%	59.1%	70.4%	79.7%	72.2%
	Total			22	81	59	162

 $<sup>\</sup>chi^2 = 5.704^{a}$  df = 2 p = 0.058 $\chi^2 = 3.657^{b}$  df = 2 p = 0.161

As indicated in Table 4.31, households that cultivated cash crops faced the following food security situations; 59.1% of those with less than one acre were food secure, 70.4% of those with 1-2 acres were food secure while those with over 2 acres had a large proportion (79.7%) of food secure households. Although, it seems that the household food security situation improved with increase in farm size and cash crop production, however, this relationship was found to be insignificant at p=0.161. This implies that farm size was not be a significant determinant on whether households engaged in cash crop production or not. This was probably because there may have been no significant variation in cash crop production amongst households with different farm sizes. This was demonstrated by the small field sizes associated with cash crop production. These findings contradict observations by Oluok's (2006) who found that farm size and the amount of land cultivated are significantly related to household food security. The study by Volege (2005) in Vihiga district, Kenya also provides evidence that the amount of land owned by households is a direct indicator of household food security. However, the existing empirical evidence of the impacts of cash crops on food security is fairly mixed. A study in Nicaragua has shown that upgrading of farmers activities through specific cash crops leads only to short term

a - for those with no cash crops

b - for those with cash crops

positive impact on food security (Carter *et al.*, 2012). A large cross-country study by IFPRI in several countries (Gambia, Guatemala, Kenya, the Philippines and Rwanda) with policies for transforming subsistence production into cash crops raises issues on the consequences of such interventions (Von Braun and Kennedy, 1994). Studies indicate that the impact of cash crops is that of a worsening situation where subsistence food production has been abandoned after cash crops have been introduced (Blanken *et al.*, 1994).

#### 4.7.4.2 Farm Size, Food Crop and Household Food Security Situation

Food crop production is a popular form of land use and only a small proportion of households (1.4%) did not grow any food crops. Households who cultivated food crop appeared to improve their food security status with increase in farm size, for example, 46.3% of those with less than one acre of land were food secure and the proportion increased to 65.7% for those with one to two acres as shown in Table 4.32. A high proportion of households (80.3%) who owned more than two acres were food secure.

Table 4.32: Farm Size, Food Crop and Household Food Security Situation

Whet	her cultivates			Appr	_		
food	crop			< 1 acre	1-2 acre	> 2 acres	Total
No	Household food	Food	Count	0	2		2
	security situation	insecure	%	.0%	100.0%		66.7%
		Food secure	Count	1	0		1
			%	100.0%	.0%		33.3%
	Total			1	2		3
Yes	Household food	Food	Count	22	34	13	69
	security situation	insecure	%	53.7%	34.3%	19.7%	33.5%
		Food secure	Count	19	65	53	137
			%	46.3%	65.7%	80.3%	66.5%
	Total			41	99	66	206

a - for those with no food crops

<sup>&</sup>lt;sub>b</sub> - for those with food crops

The results show a high Chi-square value (13.16) and a high confidence level (p = 0.001) which indicates that the three variables were significantly associated. Cramer's V of 0.253 also supports the findings and shows that a significant relationship exists among the three variables. Results from the study area therefore point to the probability that households with more land were able not only to grow more food but also engage in other land uses that would provide income to finance other household needs, thereby cushioning them from selling the food they produce and availing most of it for household consumption. These findings concur with those of Feleke *et al.* (2005) who found that farm size was significantly related to household food security in Southern Ethiopia. A study based in Sekyere-Afram plains of Ghana (Aidoo *et al.*, 2013) also showed that farm size was positively and significantly related to the probability of households being food secure. These findings, however, contradict Sikwela (2008), whose study in Zimbabwe found that farm size was negatively related to household food security.

#### 4.7.4.3 Farm Size, Fruits and Vegetable and Household Food Security Situation

Fruits and vegetables was a popular land use amongst the study population therefore households who did not grow them were few (5.7%) and their inclusion in the analyses resulted in most cells having inadequate frequencies (Table 4.33).

Table 4.33: Farm Size, Fruits and Vegetable and Household Food Security Situation

Whet	her cultivates			Approxi	_		
fruits	or vegetables			< 1	1-2	> 2	Total
No	Household food	Food	Count	2	0	0	2
	security situation	insecure	%	50.0%	.0%	.0%	16.7%
		Food secure	Count	2	1	7	10
			%	50.0%	100.0%	100.0%	83.3%
	Total		Count	4	1	7	12
Yes	Household food	Food	Count	20	36	13	69
	security situation	insecure	%	52.6%	36.0%	22.0%	35.0%
		Food secure	Count	18	64	46	128
			%	47.4%	64.0%	78.0%	65.0%
	Total		Count	38	100	59	197

Cramer's V = 0.221

a - for those with no fruits/vegetable

b - for those with fruits/vegetable

As portrayed in Table 4.33, households that cultivated fruits and vegetables were associated with following Chi-square results; 52.6% of those who owned less than one acre were food insecure while 47.4% were food secure. The results for households who owned 1 - 2 acres and greater than 2 acres showed improved food security situation of 64.0% and 78.0%, respectively. Generally, 65% of households who had cultivated fruits and vegetables were food secure compared to 35% who had not.

These results show that as farm sizes increased, the household food security situation improved especially among households who cultivated fruits and vegetables. This relationship was found to be significant at p=0.008 implying that the three variables were significantly related. In addition, Cramer's V of 0.221 supports these findings indicating that a significant relationship among the three variables. The reason for the significant relationship may be that as farm sizes increased households were able to allocate more land for fruit and vegetable production whose surpluses could be sold to earn household income which could be used to purchase food. This is in agreement with Van Der Veen and Tagel (2011) findings that, food production can be increased through expansion of areas under cultivation, and with large farm sizes, households can produce more or even diversify their activities.

### 4.7.4.4 Farm Size, Pasture and Napier Grass and Household Food Security Situation

The analysis of the relationship between farm size and household food security situation for those households that had pasture and napier grass as a land use, showed that there were more food secure households (69.1%) compared to those who were food insecure (30.9%) as Table 4.34 shows.

Table 4.34: Farm Size, Pasture / Napier Grass and Household Food Security Situation

Do yo	ou grow			App	Total		
pastu	re/napier grass			< 1 acre	1-2 acre	> 2 acres	
No	Household food	Food	Count	6	5	1	12
	security situation	insecure	%	85.7%	62.5%	33.3%	66.7%
		Food	Count	1	3	2	6
		secure	%	14.3%	37.5%	66.7%	33.3%
	Total			7	8	3	18
Yes	Household food	Food	Count	16	31	12	59
	security situation	insecure	%	45.7%	33.3%	19.0%	30.9%
		Food	Count	19	62	51	132
		secure	%	54.3%	66.7%	81.0%	69.1%
	Total			35	93	63	191

 $\chi^2 = 2.705^a$  df = 2 p = 0.259  $\chi^2 = 8.002^b$  df = 2 df = 2 df = 2 df = 2 df = 2

Cramer's V = 0.205

Respondents who owned less than one acre of land had 54.3% food secure households and this proportion increased to 66.7% in households of farm sizes of 1-2 acres. There was a high proportion of food secure households (81.0%) among respondents who owned more than two acres of land. The results clearly indicate that households' food security situation was positively related with increase in farm size and production of pasture and napier grass.

Table 4.34 shows that the Chi-square value was 8.002 with a significance value of p=0.018 which indicates that farm size has a significant impact on food security among households who had adopted pasture and napier grass as a land use. Similarly, Cramer's V of 0.205 supports the findings although indicating a weak significant relationship among the three variables. The situation in the study area is that households with more land are able to plant more napier grass for sale and also keep livestock which provide milk which is sold to earn income that may be used to purchase food stocks. These findings are in agreement with those of Esenu (2005) that the amount of land owned by households has a positive impact on food availability in Teso farming systems. Her study also showed that income realized from livestock enterprises significantly contributed to household food security status of respondents and that the

a - for those with no pasture/napier

b - for those with pasture/napier

number of livestock owned had a direct relationship with their food security. A study by Sansoucy (2003), on the contribution of livestock to food security and sustainable development showed that livestock gives increased economic stability to households acting as a cash buffer and a capital reserve against inflation. For instance, livestock reduces the risk through diversification of production and income sources therefore households have greater ability to deal with seasonable crop failures. Livestock also represents liquid assets which can be used at any time thus adding stability to the production system.

#### 4.7.5 Household Income, Land Use and Household Food Security Situation

Household food security depends, among other factors on the household's access to food through purchase. Households who do not produce enough food purchase it if their income level enables them to do so. The average household income among the sampled population was about Kshs 81,000 per annum. Agriculture was the main source of household income although 32% of the respondents earned salaries and wages. Some income was also received from remittances from household members engaged in income earning activities outside the farm and also from sale of assets. Cash crops were the most important source of agricultural income followed by food crops, then pasture and napier and finally fruits and vegetables. The following section presents an analysis of the influence of household income on household food security in relation to the four land use types namely; cash crop, food crop, fruits and vegetables and pasture and napier grass.

### 4.7.5.1 Household Income, Cash Crop and Household Food Security

Most households (77.5%) were found to be engaged in cash crop production while 22.5% reported to have no cash crops. The majority (76.6%) of those households who did not have cash crops earned less than Kshs 120,000 per year and most of them (58.3%) were food insecure as shown in Table 4.35.

Table 4.35: Household Income, Cash Crop and Household Food Security Situation

When	ther cultivates	3		Total	(Kshs	Total			
cash	cash crop			<120	120-	240-	360-	>480	
					240	360	480		
No	Household	Food	Count	21	5	0	-	-	26
	food	insecure	%	58.3%	50.0%	0%	-	-	55.3%
	security	Food	Count	15	5	1	-	-	21
	situation	secure	%	41.7%	50.0%	100.0%	-	-	44.7%
	Total			36	10	1			47
Yes	Household	Food	Count	41	2	0	1	1	45
	food	insecure	%	32.8%	8.7%	0%	100.0%	25.0%	27.8%
	security	Food	Count	84	21	9	0	3	117
	situation	secure	%	67.2%	91.3%	100.0%	.0%	75.0%	72.2%
	Total			125	23	9	1	4	162

$$\chi^2 = 1.485^a$$
  $df = 2$   $p = 0.4769$   $\chi^2 = 11.823^b$   $df = 2$   $p = 0.019$  Cramer's  $V = 0.270$ 

From the analysis, households with higher incomes (Kshs 120,000 - 240,000), recorded reduction in food insecurity by 50.0%, and the rest of the household income level categories had cell frequencies of less than five. The analysis also revealed that most households who cultivated cash crops (72.2%) were food secure compared to those without any cash crop (44.7%). For those households who earned less than Kshs 120,000 per year, 67.2% were food secure while 32.8% were not. The food security situation improved to 91.3% among households that were food secure and with income level of Kshs 120,000 - 240,000. This showed that higher income levels were positively related to household food security situation, among cash crop producers. This relationship was found to significant at p=0.019 which shows that higher income levels were positively related to household food security situation among cash crop producers. Similarly, Cramer's V of 0.270 supports the findings although indicating a weak significant relationship among the three variables. Cash crop production is a significant source of household

a - for those with no cash crop

b - for those with cash crop

income in the study area and households with higher incomes are able to meet their food needs partly through purchase thereby improving their food security situation.

These findings agree with those of Boakye-Achampong (2012) who found that farm income and off-farm income earned by farmers was significantly related to the food security status of households in Ejura-Sekyeredumasi district in Ghana. Rahim *et al.* (2011) also found that per capita income had a significant inverse correlation with household food insecurity status in Qaresoo region of Iran. Other studies, (Asogwa and Umeh, 2012; Sorre, 2011), however, argue that generation of farm income is a measure of the extent of agricultural commercialization and can affect food security negatively. This is because households are sometimes forced to sell more food when the need for income arises. This exposes them to food insecurity.

#### 4.7.5.2 Household Income, Food Crop and Household Food Security

Table 4.36 shows that only 1.4% of the households did not grow food crops. Some households also earned low incomes of less than Kshs 120,000 per year. Households who cultivated food crops performed as follows; for those who earned less than Kshs 120,000, 62.0% of the households were food secure while 38.0% were not. Most households (78.8%) with incomes ranging between Kshs 120,000 and 240,000 were food secure.

From the analysis (Table 4.36), the household food security situation improved with increase in household income for those who had cultivated food crops. This relationship was significant at p=0.019, implying that higher income levels positively influence household food security situation among food crop growing households. In addition, Cramer's V of 0.229 confirms that there existed a weak but significant relationship among the three variables; household income, food crop and household food security. Households with higher incomes are able to rely on the food they produce and have no need to sell part of it hence qualifying as 'food secure'.

Table 4.36: Household Income, Food Crop and Household Food Security Situation

				Total	_				
When	ther cultivates			<120	120-	240-	360-	>480	Total
food	food crop				240	360	480		
No	Household	Food	Count	2	-	-	-	-	2
	food	insecure	%	66.7%	-	-	-	-	66.7%
	security	Food	Count	1	-	-	-	-	1
	situation	secure	%	33.3%	-	-	-	-	33.3%
	Total			3					3
Yes	Household	Food	Count	60	7	0	1	1	69
	food	insecure	%	38.0%	21.2%	0%	100.0%	25.0%	33.5%
	security	Food	Count	98	26	10	0	3	137
	situation	secure	%	62.0%	78.8%	100.0%	.0%	75.0%	66.5%
	Total			158	33	10	1	4	206

 $<sup>\</sup>chi^2 = a^2$  (No statistics were computed because almost all cells have no frequencies)

$$\chi^2 = 10.810^{b}$$

$$df = 4$$

$$p$$
= 0. 019

Cramer's V = 0.229

These findings compare favourably well with those of Arene and Anyaeji (2010) in Enugu State, Nigeria who found that a significant relationship existed between household income and household food security and that the higher the income the greater the chances were of households being food secure.

### 4.7.5.3 Household Income, Fruits and Vegetables and Household Food Security

The growing of fruits and vegetables as a land use, was preferred by most sampled households (94.3%). Households that did not grow fruits and vegetables had fairly low incomes (Table 4.37) although most of them (77.8%) were food secure. Most of the households who produced fruits and vegetables earned incomes of less than Kshs 120,000 per annum and 65% of them were food secure while 35.0% were not.

a - for those with no food crop

b - for those with food crop

Table 4.37: Household Income, Fruits and Vegetables and Food Security Situation

			Total household income categories (Kshs)						
Whet	ther cultivates	3		<120	120-	240-	360-	>480	-
fruits	or vegetables	S			240	360	480		
No	Household	Food	Count	2	0	-	-	0	2
	food	insecure	%	22.2%	.0%	-	-	.0%	16.7%
	security	Food	Count	7	2	-	-	1	10
	situation	secure	%	77.8%	100.0%	-	-	100.0%	83.3%
	Total			9	2			1	12
Yes	Household	Food	Count	60	7	0	1	1	69
	food	insecure	%	39.5%	22.6%	.0%	100.0%	33.3%	35.0%
	security	Food	Count	92	24	10	0	2	128
	situation	secure	%	60.5%	77.4%	100.0%	.0%	66.7%	65.0%
	Total			152	31	10	1	3	197
$\chi^2 = 0$	0.800 <sup>a</sup>	df = 2	Į	p= 0. 670	0				
$\chi^2 = 1$	$\chi^2 = 10.681^{\rm b}$		p = 0.030		Cramer'	Cramer's $V = 0.233$			

As shown from the analysis (Table 4.37), when the three variables; household food security situation, level of household income and fruit and vegetable land use were crosstabulated, the results showed that 60.5% of those who earned less than Kshs 120,000 per annum were food secure. Those in the income range of Kshs 120,000 - 240,000 had a large proportion of their households (77.4%) food secure. The analysis also showed that the household food security situation improved with higher incomes particularly in households that engaged in fruit and vegetable farming. This situation was validated by a high Chi-square value of 10.68 and a significance level of p=0.030 implying that household income has a significant impact on food security situation of households that produce fruits and vegetables. Similarly, Cramer's V of 0.233 supports the findings although indicating a significant relationship among the three variables. Households with higher incomes are able to diversify from low value crops to (e.g. maize) to higher value fast maturing crops like vegetables in order to earn more income and as a result boost their food security status. These findings were in line with those of Agbola et al. (2008) who found that households in Nigeria who cultivated fruits and vegetables to supplement their income, reduced household food insecurity and that income diversification was found to have a significant influence on household food security. Ndungu (2013) also found that

a - for those with no fruits or vegetables

b - for those with fruits or vegetables

horticultural production has a positive and significant impact on household food security in Kibwezi division of Makueni district.

### 4.7.5.4 Household Income, Pasture and Napier Grass and Household Food Security

Households without pasture and napier grass (land use) were only (8.6%) and most were associated with incomes not exceeding Kshs 240,000 per year as shown in Table 4.38. Further analysis shows that 35.4% of the households in the income category of less than Kshs 120,000 and who had cultivated pasture and napier grass, were food insecure and 64.6% were food secure. For those with incomes ranging between Kshs 120,000 - 240,000 and Kshs 240,000 - 360,000 the proportions of food secure households were 82.8% and 100%, respectively. Clearly, there was a relationship among the three variables and as incomes increased so did the proportion of households who were food secure. This relationship was found to be significant at p=0.030, suggesting that household income level boosts household food security situation, especially if these households engage in raising livestock and growing of napier grass. Similarly, Cramer's V of 0.233 supports the findings although indicating a weak significant relationship among the three variables.

Table 4.38: Household Income, Pasture and Napier Grass and Food Security Situation

Whet	ther cultivates	3		Total	(Kshs)	Total			
pastu	re/napier gras	SS		<120	120-	240-	360-	>480	
					240	360	480		
No	Household	Food	Count	10	2	-	-	-	12
	food	insecure	%	71.4%	50.0%	-	-	-	66.7%
	security	Food	Count	4	2	-	-	-	6
	situation	secure	%	28.6%	50.0%	-	-	-	33.3%
	Total			14	4				18
Yes	Household	Food	Count	52	5	0	1	1	59
	food	insecure	%	35.4%	17.2%	.0%	100.0%	25.0%	30.9%
	security	Food	Count	95	24	10	0	3	132
	situation	secure	%	64.6%	82.8%	100.0%	.0%	75.0%	69.1%
	Total		Count	147	29	10	1	4	191
$p = 0.645^a$ df = 1 $p = 0.645^a$		0.423							

<sup>&</sup>lt;sub>a</sub> - for those with no fruits or vegetables

b - for those with fruits or vegetables

In the study area, households with dairy animals and poultry are able to sell milk, eggs and chicken to raise some income in order to purchase the required food making their households food secure. These findings agree with those of Terefe (2006) who found that livestock ownership was positively related to household food security in Ethiopia. Agbola *et al.* (2008) also confirmed that income diversification strategies that include crop production, rearing of livestock, had a significant influence on household food security.

In conclusion, the above analysis shows that household characteristics had an influence on agricultural land use and household food security in the study area. The gender characteristic was found to be significantly related to only two land uses namely; fruits and vegetables (p=0.007) and pasture and napier grass (p=0.036). The level of education of household head was found to be significantly related to household food security and all agricultural land uses. Household size was not significantly related with any of the land use while farm size on the other hand, was significantly associated with household food security situation, and all land uses apart from cash crop production. Household income level was a significant factor in determining household food security and was closely associated with all types of land uses. The conclusion is that the characteristics of the household head namely; gender, level of education together with household characteristics such as farm size and household income had a significant impact on agricultural land use, and household food security in the study area. This means that efforts to improve agricultural productivity and food security should not just focus on issues of land use, but should also incorporate these factors in efforts to alleviate poverty and food insecurity.

#### **CHAPTER FIVE**

#### SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

#### 5.1 Introduction

The main focus of this study was to investigate the implication of agricultural land use on household food security in Kisii Central sub-County. The specific research objectives were: (1) to examine the various land use activities in the study area, (2) to assess the food security status of households in the study area, (3) to establish the relationship between agricultural land use and household food security situation, and finally (4) to determine the influence of household socioeconomic characteristics on agricultural land use and household food security situation. This chapter provides a summary of findings related to the above objectives. It also provides sections on conclusion and recommendations.

#### **5.2 Summary of Findings**

#### Objective 1: Agricultural land use activities in the study area

Research findings showed that different households apportioned their agricultural land to different land uses but the larger part (65%) was used for food production. Cash crops were allocated about 25% of the land while the remaining 10% was allocated to production of fruits and vegetables, pasture and napier grass among other uses. The most preferred food crop was maize, followed by beans and then bananas. Among the cash crops, tea was the most preferred crop (60.3%). Napier grass growing was also a popular land use adopted by most of the households (91.4%). It was ranked the second most popular crop after maize. About 89.5% of the farm households kept livestock mostly for milk production.

#### Objective 2: Household food security in the study area

Assessment of the household food security situation showed that most of the households (77.5%) were food secure while 22.5% were food insecure. Respondents identified the main causes of food shortages as follows: scarcity of land (38.0%), low crop yields (19.5%), drought (13.5%), soil exhaustion (11.5%) and high population (8.0%). The most significant factor influencing food shortage was farm size. Households managed food shortages mainly through purchases (78%) while another 17.5% received food in exchange for their labour.

#### Objective 3: The relationship between agricultural land use and household food security

The relationship between the four categories of agricultural land use and household food security was tested and the findings are as follows;

Cash crop (land use) was positively and significantly related to household food security (p = 0.000). This means that households who had allocated land for production of cash crops such as tea, coffee or sugarcane were more likely to be food secure. This is largely because cash crops are sources of household income that could be used to buy food for households or buy inputs that would boost food production and general agricultural productivity.

**Food crop** (land use) was not significantly related to household food security (p=0.228). This implies that household food security was not dependent only on households' food production. This suggests that the mere allocation of land for food crops production does not guarantee the production of the amount of food households require.

**Fruits and vegetables** production was also not significantly related to household food security (p=0.192). This means that food availability at household level did not depend on the cultivation of fruits and vegetables. These are subsistence crops which were allocated little land resulting in low production. The income generated from their sales may not form a significant part of the money used to purchase food in households.

Pasture and Napier grass (land use) had a significant relationship with household food security (p=0.002). This implies that keeping of livestock and/or growing of napier grass contributed positively to households' chances of being food secure. Sale of livestock products such as milk provides ready cash that households may use to purchase the necessary food supplies thereby boosting their food security status. Napier grass is also sold to earn households income.

These results have established that agricultural land use had a significant influence on household food security, and that households who earn income from either cash crops and/or livestock / napier grass were more likely to be food secure compared to those who devote their land only for food crop production. The implication is that households who engage in income generating activities on their farms are able to generate some income with which to purchase food to compliment domestic production.

## Objective 4: The influence of selected household socio-economic characteristics on agricultural land use and household food security situation

The study sought to determine the influence of household socio-economic characteristics on agricultural land use and food security. These characteristics were; gender, level of education of the household head, household size, farm size and household income. Results indicate that some of these characteristics had a significant influence on how households utilized their agricultural land. This suggests that these socio-economic characteristics can potentially influence households' food security status. The most significant factors in operation were the level of education of the household head (cash crop p=0.021; food crop p=0.000; fruits/veges p=0.002; pasture/napier p=0.0008), household income (cash crop p=0.019; food crop p=0.019; fruits/veges p=0.030; pasture/napier p=0.030) and farm size (food crop p=0.001; fruits/veges p=0.008; pasture/napier p=0.018). The gender variable had a significant influence only on food security of households engaged in pasture and napier grass production.

#### **5.3 Conclusions**

Households allocated most of their agricultural land for cultivation of food crops (65%) followed by cash crops (25%) and only a small proportion was left for other agricultural activities. Food crop was therefore the most preferred agricultural land use and that shows that food production was prioritized because of the need for households to access food through their own production.

Research findings indicate that majority of the households (77.5%) were food secure while 22.5% were food insecure. It is therefore concluded that most households were able to use their entitlements to attain food security.

Agricultural land use had a significant impact on food security and households engaged in cash crop and pasture /napier production (livestock) had a higher likelihood of being food secure. The implication is that household food security depends on whether households had some source of income with which to purchase food to compliment domestic production.

Household socio-economic characteristics had a significant influence on agricultural land use and household food security. The level of education of household heads and household income had significant influence on food security of households who had adopted all agricultural land uses. The implication is that some socio-economic characteristics strongly influence the

manner in which households utilize their agricultural land resource which ultimately determines their food security status.

#### **5.4 Recommendations**

#### **5.4.1 Policy Recommendations**

There is need to improve food security among the households that are food insecure and the appropriate remedy lies in the use of extension workers to train farmers on adoption of appropriate technologies, proper agronomic practices and best practices in relation to individual farmers' land resources in order to improve agricultural productivity and food security.

There is need to improve farm incomes through commercialization of small-scale farming. The rural farming community should be assisted to form organizations to enable them become full market participants. There is also the need to explore alternative sources of income such as trade and formal employment to help to improve households' purchasing power.

The study findings indicate that certain socio-economic factors such as education and income are critical in influencing agricultural land use and food security. Such factors should be considered when policies are being made.

#### 5.4.2 Recommendations for Further Research

The scope of this study was convened to an investigation of the influence of agricultural land use on household food security in Kisii Central sub-County. The study has examined the relationship between different land uses and household food security status and also the influence of household socio-economic characteristics on agricultural land use and food security. In doing so, this study may not have provided sufficient information on some of the critical areas which may need further research.

There is need for a study to determine the present productivity level of all agricultural enterprises in the study area so as to provide technical advice on how to optimize utilization of the land resource without environmental degradation.

The experienced-based method of assessing food security has limitations therefore, there is need for assessment using other methods such as the calorie-based studies. This will assist in addressing all dimensions of household food security and their impact on the well-being of the community.

There is need for a more comprehensive study on food production in the study area given that most of the land is allocated to this activity yet households seems to depend on the market for their food needs.

Research is also needed to come up with the kind of land reforms that could bring the required structural changes. It is hoped that this would address the emotive issue of land subdivision in the study area.

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## **APPENDICES**

Appendix 1: Questionnairo	<del>,</del>	
Questionnaire Number		
Name of Interviewer		
Date of Interview		
Name of Village	Sub-location	Location
Zone		
Eligible respondent – Head o	of household or spouse	
Identify the actual responder	nt	
Head	Spouse	
Name of Respondent		
Gender Male	Female	
1. What is your age	years	
2. What is your marital stat	cus	
Married		
Single		
Widowed / Widower		
Divorced / Separated		
3. State the highest level of	school attained	
None		
Primary		
Secondary		
Post Secondary		
4. Do you have any other o	occupation apart from farming Yes	No 🗍
5. Household size Total	Number	
Child	ren less than 15	
Adult	s	

Α.	LAND USE / OV	WNERSHIP DAT	<b>A</b>				
6.	Do you own land	? Yes	] ]	No			
7.	How did you acq	uire the land					
	Inheritance						
	Allocated by fam	ily temporarily					
	Leased						
	Bought						
8.	If you own this la	and is it registered	in you	r name Yes		No	
9.	What is the appro	oximate size of you	ır land	?	ha.		
10	. If you have lease	d land what is its s	ize	1	ıa.		
11.	. Give a breakdow	n of your farm allo	ocation	l			
	Crop production		_ha.				
	Pasture / Livestoo	ck	_ha.				
	Other Specify		ha.				
12	. Proportion of far	m allocated for agr	icultu	re	%		
13.	. Please give a brea	akdown of all agric	cultura	l activities on yo	our farm ac	cording to the gi	ven
	categories.						
	Categories	Crops		Field Size	% (	of Agri. Land	
	Cash crop	1					
		2					
		3					
		4					
	Total		-				
	Food crop	1					
		2					
		3					
		4					
	Total		_				

Fruits/Vegetables	1			
	2			
	3			
TD 1	4			
Total				
Pasture/Napier	1			
Grass	2			
	3			
	4			
Total		- <u></u>		
Poultry/fish	1		·	
farming	2			
J	3			
	4			
Total	т			
Total				<del></del>
14. Indicate the crops	that have been interco	ronned		
	ed this farm since 199			
-	de information about t		` •	,
10. If yes, then provide	Crops/anima	_		Field size
Cash crop	•			
Cush Crop				
	4			
Food crop	1			
	2			
	3			
	4			
Fruits/Vegetal	bles 1			
_	2			
	<b>4.</b>			

	3				
	4				
Pasture/Napier	1				
Grass	2				
	3				
	4				
17. Identify the crops / lives	tock which have be	een abandon	ed or whose fi	eld sizes hav	e increased
or declined since 1990.					
			Year when it	was	
	Crop/enterprise	Introduced	abandoned	Increased	Decrease
Cash crop	1				
	2	<del></del>			
	3				
Food crop	1				
	2	<del></del>			
	3				
Fruits /Veget	1				
	2				
	3				
Livestock/other	1				
	2				
	3				
18. Provide an explanation v	why some crops or	livestock ha	ve declined or	increased o	ver the
vears					

19. List in the order of importance the most to the least profitable enterprise in the last 12 months.

## FARM PRODUCTION DATA

20. Provide a breakdown of the quantities of outputs from various farm activities in the past 12 months.

	Crops/Enterp	rise Total Am		verage yields necify unit)
Cash crops	1		` -	
_	2			·
	3			
Food crops	1			
	2			
	3			
Fruits/Vegetables	1			
	2			
	3			
Livestock/Napier/	1			
Others	2			
	3			
Give a summary of pure     Type of Input Who	-	on the farm for t	he past 12 mont Amount	hs. Cost
Type of Input Wil	•			
	· 			

23. W	hat is the main	source of your farm labo	our?		
a)	Family	b) Family and Hired	c) Hired only		d) Egesangio
24. Ex	xplain the labou	ır organization on your fa	arm i.e. what do wom	ien, mei	n and children do?
i.	Men (differer	ntiate between hired and l	nousehold labour)		
ii.	Women (diffe	erentiate)			
iii.					
Fa	ırm enterprise	n on labour requirements  //crops Activities	Labour requi	ired	Cost if hired
	onsidering the wards farm wo	whole farming process which which was a second control of the cont	hat contribution do ea	ach of t	he following make
M	en	Women		Childr	en
27. Li	st the crops/act	ivities associated with th	e following:		
a)	Men		Activities		
b)	Women		Activities		
c)	children		Activities		

# C: HOUSEHOLD INCOME

28. How much did	d you earn	from the following ac	tivities in the last 12 mo	nths
Cash crops	1			
	2			
	3			
Total				
Food crops	1			
	2			
	3			
Total				
Fruits/Veg.	1			
	2			
	3			
Total				
Livestock/Nap	oier/ 1			
Others	2			
	3			
Total				
29. What is the to	tal househ	old earning from agric	cultural activities Kshs_	
30. What is the %	contributi	ion of each activity.		
Cash crops				
Food crops				
Fruits / Veg.				
Livestock/Nap	oier/Others	S		
31. Provide inform	nation on o	other sources of incom	ne in the last 12 months.	
Salaries / wag	es			
Gifts				
Other (specify	<b>'</b> )			
Total				

32.	Total household income	(add 29 and 3)	1a)	
33.	Give proportions for the	following tow	ards total income.	
	Cash crop income		% of	total
	Food crop income		% of	ftotal
	Fruits / Veges income		% o	of total
	Livestock / Napier/Other	· income	% o	f total
34.	Provide a breakdown of	your househol	d expenditure in the las	t 12 months.
	Type of expenditure	Amount	<b>Sources of Income</b>	% of No. 32
	School fees			
	Food			
	Health and household			
	Agricultural inputs			
	Others (specify)			
	Totals			
35.	What is the households'	disposable inc	come (32 – 34) Kshs	
36.	Provide information about	ut food produc	ction in the last 12 mont	ths.
	Food type	Amount prod	duced on farm	How much is needed
37.	Do you sell any part of the	ne food produc		No
38.	If yes, what proportion o	f the produce	is sold?	
	Food type	Propo	ortion sold	
	1			
	2			
	3			
	4			

39.	Give	a list of diffe	erent foods	consumed in	the h	ousehold, am	ounts needed, shortages and
	surpl	uses in the pa	ast 12 mon	ths.			
	F	ood type	Amoun	t required	Sh	ortage (%)	Surpluses (%)
	1						
	2						
	3						_
40.	How	do you class:	ify your fo	od security sy	ystem	situation in th	ne past 12 months?
	1. A	dequate food	l				
	2. M	Iild shortage	(1-2  mod)	nths)			
	3. S	hortage (3-5	months)				
	4. S	evere shortag	ge (6 montl	ns and above)	)		
41.	If you	ı experience	shortage, l	now did you r	nanag	e it and in wh	at proportions.
	1. B	uying food			%		
	2. G	ifts from frie	ends		%		
	3. B	uying and gi	fts		%		
	4. W	orking for fo	ood		%		
42.	Wher	and where	do you pur	chase food an	nd at v	what cost	
	• 1	of food		Amount Quantity	y	When	Distance to market (km)
43.	Total	amount used	l to purcha	se food Kshs			
			_				
44.	List a			available wh		eded.	
		Food ty	-		Why		
		·					
		·					
		•		<del></del> -			
	4.	•					<del></del>

45.	Co	nment on the prices of the foods you buy.
	1.	Expensive
	2.	Fair
	3.	Reasonable
	4.	Cheap
46.	Wł	at is the source of money for purchasing the required food
	1.	Cash crops (what proportion)%
	2.	Food crops (what proportion)%
	3.	Fruits / vegetables (what proportion)%
	4.	Livestock / poultry (what proportion)%
	5.	Salaries / wages (what proportion)%
	6.	Gifts (what proportion)%
47.	Lis	in order of importance the factors that contribute to food shortages
	1.	
	2.	
	3.	
	4.	
	5.	
48.	Но	would you improve the present food situation in your household?
<b>E.</b> .	AG	ICULTURAL MARKETS
49.	Us	g the following categories, please specify the types of markets available for your farm
	pro	uce.
	1.	Coops and agents
	2.	Neighbours
	3.	Periodic markets
	4.	Other (specify)

1	Crops/product	Category of market	Mode of transport	Distance from farm
2	1			
3	2			
Declining Increasing  1	3			
Declining Increasing  1				
Declining Increasing  1	0. List the ones with	marketing problems.		
1	1. Identify crops wh	ose prices have been o	declining or increasing	
2	Declining	Increa	asing	
2	1			
Reasons  F. GENDER  22. Who is the key decision maker regarding utilization and management of land in this household?  1. Male head  2. Female head  3. Wife  4. Husband  5. Both  6. Others (specify)  23. What problems or benefits do these imply for the household?  a) Benefits				
Reasons  F. GENDER  52. Who is the key decision maker regarding utilization and management of land in this household?  1. Male head				
F. GENDER  52. Who is the key decision maker regarding utilization and management of land in this household?  1. Male head				
52. Who is the key decision maker regarding utilization and management of land in this household?  1. Male head	reasons			
52. Who is the key decision maker regarding utilization and management of land in this household?  1. Male head				
52. Who is the key decision maker regarding utilization and management of land in this household?  1. Male head				
household?  1. Male head  2. Female head  3. Wife  4. Husband  5. Both  6. Others (specify)  33. What problems or benefits do these imply for the household?  a) Benefits	F. GENDER			
household?  1. Male head  2. Female head  3. Wife  4. Husband  5. Both  6. Others (specify)  33. What problems or benefits do these imply for the household?  a) Benefits	70 W/h = ! = 4h = 1 1-			
1. Male head		cision maker regardin	ig utilization and mana	igement of rand in this
2. Female head				
3. Wife 4. Husband 5. Both 6. Others (specify) 3. What problems or benefits do these imply for the household?  a) Benefits				
4. Husband  5. Both  6. Others (specify)  3. What problems or benefits do these imply for the household?  a) Benefits	2. Female he	ad		
5. Both 6. Others (specify) 3. What problems or benefits do these imply for the household? a) Benefits	3. Wife			
6. Others (specify)	4. Husband			
a) Benefits	5. Both			
a) Benefits	6. Others (sp	ecify)		
a) Benefits	53. What problems or	benefits do these imp	oly for the household?	
	-	-	•	
	<i>u)</i> Benefits			
b) Problems	h) Problems			
<i>0)</i> 1100101118	o) Hoolellis			

54.	Wł	o makes decision regarding what to plant
	1.	Male head
	2.	Female head
	3.	Wife
	4.	Husband
	5.	Both
	6.	Others (specify)
55.	Wł	o makes decisions about sale of farm produce?
	1.	Male head
	2.	Female head
	3.	Wife
	4.	Husband
	5.	Both
	6.	Others (specify)
56.	If y	ou are a female head of family how much land do you ownacres
57.	Но	w did you come to own this land?
	1.	Inheritance
	2.	Through spouse
	3.	Purchase
	4.	Rented
	5.	Other (specify)
58.	Wł	ich crops do you prefer to grow?
	1.	
	2.	
	3.	
		Why
59.	Is t	nere a crop you cannot grow because of your gender?
	Wł	y

60. Which livestock do you kee	p?	
1		
2		
3	<del></del>	
61. Is there some livestock that	you cannot keep because o	f your gender?
1	<del></del>	
2	<del></del>	
3		
Why		
62. Are there certain crops that	you are expected to grow b	ecause of your gender?
1		
2	<del></del>	
3		
G. AGRICULTURAL INFOR	RMATION	
63. What is the main source of y	our agricultural informatio	on?
1. Extension workers	$\neg$	
2. Neighbours		
3. Mass media		
4. Organization (specify)_		
5. Other (specify)		
64. Have you had contact with 6		
Yes N		
65. If yes, then explain the type	of contact and for which cr	op/activity
Contact	No of Items	Crop/animal/activity
a) Home visit		
b) Office consultation		
c) Barazas		
d) Others (specify)		

				_	
	Are you satisfied with the extension services given? Yes No				
	/hy				
58.	How do you thir	ık agricultural	extension can b	e improved?	
_					
– 59. H	Iave you taken an	agricultural loa	an for the past 1	2 months? Yo	es No
	f yes, provide the f		-		
	ource of credit	Amount	Purpose	Security	Repayment/Period
			•	v	1 0
_					
If	f no. give reasons				
If	f no, give reasons_				
_					
- 70. <b>V</b>	Which kind of agric	cultural techno	ology have you is	ntroduced in th	ne past 10 years?
- 70. <b>V</b>		cultural techno	ology have you is	ntroduced in th	
- 70. <b>V</b>	Which kind of agric	cultural techno	ology have you is	ntroduced in th	ne past 10 years?
- 70. <b>V</b>	Which kind of agric	cultural techno	ology have you is	ntroduced in th	ne past 10 years?
- 70. <b>V</b>	Which kind of agric	cultural techno	ology have you is	ntroduced in th	ne past 10 years?
 70. W K  	Which kind of agric	cultural techno y Crop/A	ology have you in activity	ntroduced in th	ne past 10 years?
	Which kind of agric  Kind of technology  NVIRONMENT	cultural techno y Crop/A	ology have you in activity (	ntroduced in th	ne past 10 years?  Who introduced it
	Which kind of agric  Kind of technology  NVIRONMENTA  Iow would you con	cultural techno y Crop/A	ology have you in activity (	ntroduced in th	ne past 10 years?  Who introduced it
	Which kind of agric  Kind of technology  NVIRONMENTA  Iow would you con  Enough	cultural techno y Crop/A	ology have you in activity (	ntroduced in th	ne past 10 years?  Who introduced it
70. W  K  71. H  1	Which kind of agric  Kind of technology  NVIRONMENTA  Iow would you con  Enough  Fair	cultural techno y Crop/A	ology have you in activity (	ntroduced in th	ne past 10 years?  Who introduced it
70. W K	Which kind of agric  Kind of technology  NVIRONMENTA  Iow would you con  Enough  Fair  Not enough	cultural techno y Crop/A	ology have you in activity (	ntroduced in th	ne past 10 years?  Who introduced it
70. W K	NVIRONMENT A Iow would you con Enough Not enough Too much	Crop/A  Crop/A  AL FACTORS  Insider the amo	slogy have you in activity (	ntroduced in the	ne past 10 years?  Who introduced it

73.	How would you consider your soils? 1. Fertile 2. Infertile
74.	Which crops are limited by your kind of soil?
	1
	2
	3
75.	List some of the problems associated with your soils
	How do you solve them?
76.	How do you contain soil erosion on your farm?  1
	<ol> <li>2</li></ol>
77.	How would you describe the slope of your land?
	1. Gentle
	2. Steep
	3. Gentle and steep
78.	How does the slope impact on your farming activities?

### **Appendix 2: Research Authorization**

#### MINISTRY OF EDUCATION, SCIENCE & TECHNOLOGY

Telegrams: EDUCATION", Nairobi

Fax No.

Telephone: 318581

When replying please quote



**JOGOO HOUSE** HARAMBEE AVENUE P. O. Box 30040 **NAIROBI KENYA** 

MOEST 13/001/35C 466/2

3rd October, 2005

Janepha Kemunto Kumba **Egerton University** P.O. BOX 536 NJORO

Dear Madam

#### RE: RESEARCH AUTHORIZATION

Please refer to your application for authority to conduct research on "Agricultural land use and its implications on food security in Kisii District, Kenya". This is to inform you that you have been authorized to conduct research in Kisii District for a period ending 30<sup>th</sup> August, 2006.

You are advised to report to the District Commissioner and the District Education Officer Kisii District before embarking on your research project.

Upon completion of your research, you are expected to submit two copies of your research findings to this Office.

Yours faithfully

FOR: PERMANENT SECRETARY

Cc

The District Commissioner

**Kisii District** 

**The District Education Officer Kisii District** 

## **Appendix 3: Research Permit**

# OFFICE OF THE PRESIDENT PROVINCIAL ADMINISTRATION AND INTERNAL SECURITY

Telephone: Kisii 20606/7/8 When replying please quote

Ref. No. ....

and date

All Divisional District Officers, **CENTRAL KISH DISTRICT.** 

OFFICE OF THE
DISTRICT COMMISSIONER
9th Novemble 2905
KISH

....., 20.....

#### RE: RESEAR #AUHTORISATION JANEPHA KEMUNTO KUMBA

This is to inform you that the above named has been authorized to conduct research on :Agricultural Land Use and its implications on food security in Kisii District, Kenya" in the District.

Kindly accord her the assistance she may require.

#### J.M. KISANGAU

( J.M. KISANGAU ) for: DISTRICT COMMISSIONER CENTRAL KISH DISTRICT

c.c.

Janepha Kemunto Kumba, Egerton University,

P.O. Box 536,

NJORO.