FACTORS INFLUENCING MAIZE CROP PRODUCTION AMONG SMALL-SCALE FARMERS IN KURIA EAST SUB-COUNTY, MIGORI COUNTY, KENYA.

PAULINE WEGESA NYAMOHANGA

A Thesis Submitted to Graduate School in Partial Fulfillment for the Requirement for the Award of the Degree of Master of Science in Geography of Egerton University

EGERTON UNIVERSITY

DECEMBER, 2017

DECLARATION AND RECOMMENDATION

Declaration

This thesis is my original work and has not been presented for an award of a diploma or conferment of a degree in this or any other university.

Signature…… Date……

Pauline Wegesa Nyamohanga

NM13/2418/09

Recommendation

This thesis has been submitted for examination with our approval as the university supervisors.

Signature…… Date……

Prof. Francis N. Wegulo, Ph.D.

Department of Geography

Egerton University

Signature…… Date……

Prof. Kennedy N. Ondimu, Ph.D.

Department of Geography

Egerton University

COPYRIGHT

DEDICATION

This thesis is dedicated to my dear husband Mr. Mwikwabe Christopher.

ACKNOWLEGMENTS

First and foremost, I am grateful to the Almighty God for granting me good health, strength, willpower and ability to do my work to completion. Second, I would like to thank Egerton University for giving a chance to pursue this degree. I wish to express my sincere gratitude to my supervisors and mentors, Prof. Francis. N. Wegulo and Prof. Kennedy Nyabuti Ondimu of the Department of Geography, Egerton University for their sincere support throughout my study. Their constructive criticisms and comments significantly contributed to the writing of this thesis. I also wish to pay tribute to all the academic staff of the Department of Geography, especially Dr. Charles Recha, the Head, and the academic staff in the Faculty of Environment and Resources Development. Their comments and constructive criticisms greatly assisted in improving this thesis.

I would like to acknowledge the support and assistance given to me by Dr. Naomi Rioba and Dr. Chacha Kerata and their entire family for providing me accommodation, advice, encouragement and prayers in the course of doing my postgraduate studies. I also extend my appreciation to Charles Chacha, and Ivan Kerario (Chiefs of Kegonga and Ntimaru Locations, respectively) for providing assistance in the course of field data collection. Stephen Maswage, Meteti Gichonge and Frimbongs Kigwena accorded me financial support during data collection. Thank you all. Mr. Obura Marvin provided statistical support during data analysis, I appreciate your assistance.

I am grateful to Mr. Joash Kwenya and Mrs. Mulwale Catherine (crop officers) of the Ministry of Agriculture and Development, Kuria East sub-County for data on maize production. Musa Chirchir and Joseph Ochien'g of Kisii Meteorological Station provided me with rainfall data. My appreciation is further extended to my colleagues: Innocent Ong'oki, Ochien'g Richard, Janerose Wafula, Otiso Clifson and Johnnes Mwita for sharing useful ideas and their encouragement during the entire period of my study and research.

Finally, I express my gratitude to my dear husband Mwikwabe Christopher for his financial support throughout my studies; my lovely daughters Naomi Ghati, Immaculate Nyanting'a, and sons Festus Nyamohanga, Virgilio Bosensera, Martin Ikwabe, Joseph Mokami; and my sister in law Nchagwa Pauline for their encouragement, prayers, patience, goodwill and understanding during the time I was away pursuing my studies. Above all, I thank my parents, Mr. Paul Nyamohanga and Mrs. Mary Nyanting'a for their unconditional love, for encouragement to always pursue and enjoy learning. God bless you all.

ABSTRACT

Maize is the main staple food crop in Kenya and is of vital concern to agricultural policy decisions, food security and overall development of the sector and the economy. It is also the dominant staple food crop in Kuria east sub-County. However, there has been a declining trend in maize production among farmers in the study area threatening household food security. This study was conducted in Kuria east sub-County using cross sectional survey research design and sought to achieve the following objectives: to determine the role of household level factors in influencing maize production in the study area; to determine the influence of environmental level factors on maize production; to examine the role of other agricultural land use practices on household maize production and to assessment of household food status and adoption of the mitigation measures used to overcome food shortage in the study area. A sample of 316 households was selected through stratified and systematic sampling techniques from Kegonga and Ntimaru divisions. Data was collected by use of pretested questionnaire and Key Interview Schedule. Key Informants were picked through purposive sampling method. Rainfall validated data for the period 2010-2014 was obtained from Kisii meteorological station while maize yield for the period 2010-2014 was collected from the Ministry of Agriculture office in Kuria east sub-County. Microsoft Office SPSS software, version 20 was used to analyze the data. Descriptive and inferential statistics was used to analyze household level factors affecting maize production and the mitigation measures adopted by the farming households to curb food shortage. Data presented in this study support the following findings: household level factors have a significant influence on maize production, farming households have varied perceptions on environmental level factors and their effect on maize production; incomes received from sale of cash crops have greatly helped in the purchase maize, especially during periods of food shortage; the study area has adequate food which has been made possible by the adoption of a number of mitigation measures by households during food shortage. Based on these findings, although majority of the households in the study area have adequate food supply a small proportion is faced with food shortage. This calls for formulation of specific and elaborate policies to more effectively address food deficits at both household. The study thus made the following recommendations; there is need to encourage cash crops farmers to ensure that they use the income earned cash crop growing to purchase food stock. Farming households should be encouraged to engage in non-farm activities as an alternative source of income to help cushion and increase food assets during the period of food shortages.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

AGRA	-	Alliance for Green Revolution in Africa
CAAP	-	Comprehensive African for Agricultural Program
CAN	-	Calcium Ammonia and Nitrogen
CBS	-	Central Bureau of Statistics
DAO	-	District Agriculture Office
DFID	-	Department for International Development
EU	-	European Union
FAO	-	Food for Agriculture Organization
FEWSNET	-	Famine Early Warning System Network
FAOSTAT	-	Food and Agricultural Organization Statistical Databases
GDP	-	Gross Domestic product
GoK	-	Government of Kenya
GFS	-	Global Food System
IFPRI	-	International Food Policy Research Institute
JFMAM	-	January, February, March, April, May
KARI	-	Kenya Agriculture Research Institute
KGFSSG	-	Kenya Group Food Security Steering Group
KNBS	-	Kenya National Bureau for Statistics
MLND	-	Maize Lethal Necrotic Disease
MoA	-	Ministry of Agriculture
NCPB	-	National Cereals and Produce Board
NCST	-	National Council for Science and Technology
NDVT	-	Normalized Difference Vegetation Index
NFSNP	-	National Food Security and Nutrition Policy
OND	-	October, November, December
PRSP	-	Poverty Reduction Strategy Paper
SAF	-	Standard Analytical Framework
SPSS	-	Statistics Package for Social Sciences
SRA	-	Strategy for Revitalizing Agriculture
WCED	-	World Commission on Environment and Development
WCED	-	World Commission on Environment and Development
WFP	-	World Food Programme
WFS	-	World Food Summit

CHAPTER ONE
INTRODUCTION

1.1. Background to the Study Problem

Maize is one of the most important cereal crops in the world, in agricultural economy as food for human beings, with the largest producer being the United States, producing 42%. It is one of the world's leading crops cultivated over an area of about 142 million hectares with a production of 637 million tons of grain (FAOSTAT, 2014).In the second half of the twentieth century, steady progress was made in increasing per capita maize availability in the world (FAO, 2009). However, despite the increase in maize production, hunger and food insecurity are still major problems that beset the world (Garratt Glass, 2015).

The world is faced with a situation where eight hundred and forty two million people do not have enough to eat (GFS, 2016). Vast majority of hungry people eight hundred and twenty seven million live in developing countries, where 14.3 percent of the population is undernourished yet the world produces enough food to feed everyone with at least 2,720 kilo calories per day (FAO, 2006). This is well above the Food and Agriculture Organization of the United Nation's recommended minimum of 2250 kilo calories (FAO, 2003a). Ironically food insecurity remains globally widespread and stubbornly high.

In sub-Saharan Africa, the number of undernourished people and persistent chronic nature of food problem increased from 169 million in 1992 to 206 million in 2003 and by 2015, FAO (2006) estimated that 30 percent of the undernourished people live in developing world, compared with 20 percent in 1992. Most of the maize produced and consumed in Africa comes from smallholder rural farms. Production takes place under difficult conditions characterized by poor soils; low-yielding varieties; inadequate access to yield-enhancing inputs such as fertilizers and improved seeds; inadequate access to finance by producers, suppliers and buyers; and variable climatic and environmental conditions (FAOSTAT, 2007). Moreover, three-quarters of those affected live in rural areas and include those who have been displaced by civil conflicts and also those who scratch their living from dry lands where adequate rainfall for maize production is a constant challenge (FAO, 2003; 2006). In the West Africa sub-region; for example in Liberia, Sierra Leone and Nigeria are among those countries with the highest rate of

undernourished in the continent (Babatunde, Omotesho and Sholota, 2007). Fortunately, governments and development partners around the continent have put in place various rural development programs that seek to subsidize farm inputs such as fertilizer costs in order to make them widely available to the farmers (FAO, 2002).

The horn of Africa is one of the world's most food insecure regions. The eight countries; Djibouti, Ethiopia, Entrea, Kenya, Somalia, Sudan, South Sudan and Uganda are prone to extreme food shortages. This is caused by a variety of factors including; drought, environmental degradation, poverty, conflict, population growth, land fragmentation and stagnating agricultural development (FAO, 2000). Food supplies in large parts of developing world are locally derived and much of the agriculture is rain fed. As a result, rainfall and temperature changes directly influence food supply. In Kenya, 3.75 million people are considered food insecure (FEWS NET, 2011).

The above countries have been facing severe food insecurity problems despite the new seventeen Sustainable Development Goals (SDGs) which include significant number of interconnected objectives related to agriculture and food (UN, 2013). SDGs formed part of a wider 2030 agenda that was built on the Millennium Development Goals (MDGs) which was supposed to be achieved in 2015 (FAO, 2003a). A further process was required to agree and develop development goals from 2015-2030. The goals of MDGs set by United Nations back in the year 2000; to eradicate poverty, hunger, illiteracy and disease were concrete, specific and measurable and therefore helped establish some priority areas of focus in international development (UN, 2014). But that was one of the biggest criticisms that led to the development of the seventeen Sustainable Development Goals, which sought to take all the failings of MDGs in to account. SDGs focus explicitly on food by seeking to end hunger, achieve food security and improved nutrition and promote sustainable agriculture.

Maize is the main staple food crop in Kenya whose consumption is widespread across the country and among households in the study area and is of vital concern to agricultural policy decisions, food security and overall development of the sector and the economy (MoA, 2006). However, there has been a declining trend in maize production among farmers in Migori County

and Kuria east Sub-County, threatening household and national food security (Olwande, 2012).

Migori County and Kuria East sub-County in particular faces household food insecurity and approximately 60 percent of the arable land is under cash crop, 30 percent under food crop and 10 percent is left fallow. The large non arable land is due to the unreliable rains in some constituencies such as Nyatike and Kuria (GoK, 2013-2017). Soil fertility has declined due to continuous cropping and this has a negative impact on food production as most crops are associated with low yields (Olwande and Mathenge, 2010).The above constrains cause farmers to undertake their farming activities sub optimally particularly maize crop production thus becoming food insecure.

Rainfall is the leading factor that influences maize growth and productivity (DAO, 2014). The variability of rainfall at the start of the season as well as mid-season breaks in the rains often result in poor maize establishment and yield reduction. Although single rains may wet the soil sufficiently for planting, these events may be followed by long dry spells (Barrios, Ouattara and Strobl, 2008). Even in those regions where rainfall is high, individual events are often characterized by severe storms, resulting in considerable loss of rainfall in run-off. Hence decisions on the timing of farming operations and crop management after a rainfall event have to be made quickly and efficiently (Hoogmoed and Klaij, 1990). Kuria east sub-County is typically rain fed agricultural region, where the scarcity of rainfall in both the amount received and in distribution, have continued to pose major threat to agricultural food production (GoK, 2008). This has contributed significantly to the poor yield and high variability in maize crop production from year to year (Appendix C).

Currently, maize is the main staple food of the majority households of Kuria East sub County and it is widely produced on small scale (DAO, 2015). The major factors that would be affecting maize production in other areas are; environmental factors (rainfall distribution and soil fertility); socio-economic factors (gender relations, age of the household head, education level, agricultural extension services, land tenure, household size, farm size, household income) and other agricultural land use practices.

1.2 Statement of the Problem

Studies which have addressed issues related to maize crop production in Kenya, have tended to consider the problem from national or regional points of view. Thus, while aggregate data are generally available at the national level, little work has been done to understand the maize crop production problem at the household level. National food balance data is not sufficient to providing an understanding of the food security dynamics at sub-national levels. Most agricultural maize crop production comes from millions of rural households. Despite the increasing global concern of improving food security, the nature and extent of food security at the household level in rural areas particularly Kuria East sub-County is not well documented. This raises a number of questions with regard to household maize crop production and implications to food security in the study area: What are the household level factors influencing maize crop production in the study area? What are environmental (rainfall distribution and soil fertility) level factors influencing maize crop production in the study area? What role do other agricultural land use practices play on household maize crop production in the study area? What do mitigation measures play, if any, to ensure adequate food in the study area? This study therefore sought answers to these critical questions with a focus on factors influencing maize production among small-scale farmers in the study area.

1.3 Objectives of the Study

1.3.1 Broad Objective of the Study

The broad objective of this study was to examine factors influencing maize crop production among small-scale farmers at household level in Kuria east sub-County.

1.3.2 The specific objectives

This study was guided by the following specific objectives:

1. To determine the role of household and level factors influencing maize crop production in the study area.
2. To determine the environmental level factors influencing maize crop production in the study area.
3. To examine the role of other agricultural land use practices on household food crops production.
4. To determine household food status in the study area.

1.4 Research Questions

1. What are household level factors influencing maize crop production in the study area?
2. What are environmental level factors influencing maize crop production in the study area?
3. What is the role of other agricultural land use practices on household maize crop production?
4. What is the current food situation at household level in the study area?

1.5 Justification of the Study

Kuria East sub-County is faced by incidences of food shortage (GoK, 2013-2017).The study therefore aimed at establishing the factors influencing maize crop production in Kuria east sub-County. The findings of the study will be shared and discussed among Kuria East sub-County stakeholders (Crop officers, NGOs and small-scale farmers) to provide relevant data to stakeholders and enable them plan for future maize production as this is expected to help build farming capacity among the small scale farmers. The findings will also be shared with the Ministry of Agriculture to provide relevant input in policy making in the study area concerning household maize production and small scale farming practices. The findings will finally contribute to the body of knowledge in the academia and may provide insights on food security gaps for further academic research.

1.6 Scope of the Study

The study focused on validation of households' perception on environmental level factors (rainfall variability and soil fertility) and socio-economic factors influencing maize production in the study area. The influence of rainfall on maize production was examined through data spreading over five (5) years (2010-2014), and also through farmers' perceptions on soil fertility.

1.7 Limitations of the Study

The researcher encountered the following problems during data collection: the language barrier limitation as some of the respondents who were farmers in the local study area were not in a position to communicate in the same dialect fluently. The researcher solved this by the translating English into Kiswahili which was understood by the respondents; travelling long distance to interview respondents due to widely distributed households, this was solved by using a motorcycle to access the sampled households.

1.8 Operational Definitions of Key Terms and Concepts

Economic factors: Refers to various sources of income and livelihoods of smallholder farmers of Kuria East and the size of land owned by farming households and other competing land use practices.

Environmental factors: Refer to rainfall amount, number of rainy days and dry spells and soil fertility.

Farming experience: Refers to the number of years a smallholder farmer has been engaged in farming on a continuous basis, either in the study area or elsewhere.

Maize crop production: According to this study it is the proportion of maize grown for subsistence purposes as the staple food.

Adequate food: According to this study it is when farming households have enough food to take them from one season (eight months) to another.

Gender: Refers to culturally and socially constructed differences between men and women. In this study for example, men and women headed households have differentiated access to resources (land, capital) which affect their capacity to produce maize crop.

High and Low Yield of maize: According to this study high maize yield is 20 bags of 90 kilograms per acre, average yield is between 10-15 bags of 90 kilograms per acre and low yield below 10 bags of 90 kilograms.

Household level factors: According to this study these factors include income level, size if household, land tenure, size of land and decision maker.

Household: Refers to people who live together in a single home and who are involved in maize crop production practicing small-scale farming. In this study the household is represented by the household head who was interviewed to provide the necessary information.

Income level: Refers the amount of money earned by the respondent per day, week or month from either business or employment in agricultural or non-agricultural activities.

Inadequate food: According to this study it refers to when farming households have no enough maize to take them form one season (eight months) to another.

Individual level factors: Refer to factors which include age of the household head, gender, education level and perception of environmental factors.

Land size: Refers to the farm area measured in hectares used by farming household to produce maize crop.

Land tenure: Refer to the type of land ownership by a farming household head.

Level of education: According to this study, level of education is the number of years completed at a formal school system by the head of farming household. Education is thus divided into three critical levels namely: primary, secondary and tertiary.

Other Agricultural Land use practices: Refer to practices different from maize crop production, for example the growing of tobacco, coffee, rearing of livestock keeping and fish farming.

Perception on environment: Refer to small scale farmer's rating of the ability of rainfall variability to sustain plant productivity within natural or managed ecosystem. The perception of rainfall was categorized as; reliable rain throughout the year, satisfactory short rain season, satisfactory long rain season and drought interfere with maize crop production.

Perception of soil fertility: Refer to small scale farmer's rating of the ability of soil to sustain plant productivity within natural or managed ecosystem boundaries. The perception was categorized as; sufficient fertile, moderately fertile, infertile soil and improved soil fertility.

Perception: According to this study perception is the way small-scale farmers think and behave in form of aggregate knowledge in addition to attitudes or beliefs held by farming households and the community on factors which influence maize production.

Policy: Refer to guiding principles and goals used by a government to address maize production. The policy accords the public an opportunity to monitor the government or the institutions on food matters.

Social factors: Refer to factors which include; land tenure and ownership, age of the household head, gender relations, education level and politics of the day.

Stakeholder: Refer to a person or group of people (crop officers and Non-Governmental organizations) with a direct interest, involvement, or investment in the activities of small-scale farmers and maize crop production aspects in Kuria east sub-County.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter provides an overview of the past review of maize production that exists in related literature. It points out the various factors that have affected maize production among small-scale farmers with specific focus to Kuria East sub-County. The factors include; perception of farmers on environmental factors (rainfall variability and soil fertility), socio-economic factors (land tenure system and ownership, gender based access right, education level of the household head, age of household head, agriculture extension service and income levels of households) and other agricultural land use practices. Theoretical and a conceptual frame works are also presented to show the relationship between the dependent and Independent variables.

2.2 Global Maize Production

Maize production in the global arena can be categorized into white and yellow maize production (GFS, 2016). White maize is biologically and genetically very similar to yellow maize. World production of white maize is currently estimated at around 65-70 million tons, representing 12-13 % of the annual world output of all maize. Maize is widely cultivated throughout the world, and a greater weight of maize is produced each year than any other grain (FAOSTAT, 2015). The United States produces 40% of the world's harvest; other top producing countries include China, Brazil, Mexico, Indonesia, India, France and Argentina (Zeng et al., 2013). FAO's preliminary estimate of the sub region's aggregate 2016 maize production points to a decrease of 3 percent from 2015, to an above-average level of 27.8 million tonnes. The anticipated contraction mainly reflects a reduced output in Mexico, which accounts for 85 percent of the sub regional total. Official forecasts put national production down 3 percent from 2015 to 23.5 million tonnes, due to anticipated lower sowings for the main 2016 spring-summer crop, currently being planted, as a result of late and below-average precipitation that delayed plantings operations (FAO, 2016).

Achieving food security in its totality continues to be a challenge in the world today (Garratt Glass, 2015). The world's household food insecurity continues to worsen as many continents struggle with daily hunger and starvation (FAO, 2016). A myriad of factors have been responsible for the continuing world food insecurity. One factor is the rise in prices of the world staple foods

(Garthwaite, Collins and Bambra, 2015). Another factor is dependence on food imports which also influences the global food insecurity. A case in point is Haiti where over 80% of staple rice is imported ultimately leaving the country exposed to the spiraling world food prices. Moreover, the climate change due to global warming has influenced world household food insecurity (World Bank, 2008).

2.3 Maize Production in Africa

Maize was introduced into Africa by the Portuguese in the 16th to 18th Century, since then it has become Africa's most staple food and feed system (FAO, 2015).Various countries in Africa have experienced the devastating effects of household food insecurity. For instance, Cameroon in West Africa, Egypt in Northern Africa, Ethiopia in the Eastern Africa and South Africa in the extreme Southern Africa. The World Food Programme (WFP) describes Cameroon as a food insecure country, and has further demonstrated that food intake in households is lower now than in the early 1980s. (Oneworld.net (US), 2009). It is critical for African countries to increase maize production in order to feed their people. According to FAO and WFP (2004; 2005) the production of the country's staple food, maize was on a long term decline, dropping by 70% over many years in most areas. This was due to non-cultivation of the arable lands, delayed rainfall and the high risk of making loss from agriculture as well as shortage of seeds for alternative crops among others.

In 2000, world leaders committed themselves to the Millennium Development Goals (MDGs) and one aim of the MDGs was to eradicate poverty and hunger (UN, 2015). The target was "to reduce by half the proportion of people who suffer from hunger" by 2015 (Gyamfi, 2006). Nevertheless, nearly a billion people remain hungry even after the recent food and financial crises have largely passed indicates structural problem that gravely threatens the ability to achieve internationally agreed goals on hunger reduction (UN, 2015). Consequently, food production, distribution, and consumption are perhaps the most important economic activities in Africa as elsewhere in the world (Breman, 2003). The agricultural sector in Africa is stagnant, and maize production, which is mainly subsistence oriented lags behind the already low growth of agriculture. Many African countries experience food insecurity at both the national and household levels (Babatunde *et al*., 2007). Africa has the highest prevalence of under nourished population. In some countries, the rate of under nourishment is above 40%, while it exceeds 50% in those countries experiencing armed conflict (Todd, 2004).

Food shortage is an ongoing problem in South Africa, Liberia, Sierra Leone and Nigeria among other countries in Africa and long-term projections suggest that these countries' maize production per capita is likely to diminish into the future (FAO, 2016). This poses serious challenges to governmental and non-governmental institutions, formal and informal policy and decision makers at all levels (GFS, 2015).

2.4 Maize Production in Kenya

Maize is the main staple food crop in Kenya and is of vital concern to agricultural policy decisions, food security and overall development of the sector and the economy (Olwande, 2012). Most of the maize produced and consumed in Kenya comes from smallholder rural farms (Kimenju and Schirley, 2008). Each year, the average Kenyan consumes 98 kilograms of maize, the staple of the Kenyan diet. At the same time, maize prices in Kenya are among the highest in sub-Saharan Africa, and the poorest quarter of the population spends 28 percent of its income on the crop (Farm Management Handbook, 2007).There has, however, been evidence of stagnation in maize production and productivity increasing gap between production and consumption hence increasing frequency of supply shortages (Olwande and Mathenge, 2010).

2.5 Maize Production in Migori County

Maize is the dominant staple food in Migori County. However, there has been a declining trend in maize production among farmers in Migori County and Kuria east is not exceptional, a tobacco growing zone, threatening household and national food security (Olwande, 2012). To make matters worse, almost all the arable land is under cultivation in Migori County making future increase in maize production to depend on yield improvement rather than expansion in area under production (GoK, 2008-2012)**.** Similarly, although Migori County is home to tobacco production, many farmers live in abject poverty and are vulnerable to food insecurity thus making many to question whether switching from maize to tobacco is worthwhile. Migori County is chronically food insecure, with an average of 34 per cent of the respondents experiencing chronic food insecurity. The majority of the respondents relied on own production at 35.4 per cent, Trade/small businesses 24.5 per cent and casual labor (agriculture and non-agriculture) at 23.3 per cent, as the main source of accessing food (Ibid).

2.6 Influence of socio-economic factors on maize production

2.6.1 Gender relations and maize production

Gender roles influence the amount maize production and the kind of activity carried out by the household head, depending on whether the household head is a male or female. Unequal rights to decision making and obligations within the household, as well as limited time and financial resources, has often blocked women's potential in agriculture (FAO, 2009). Most importantly, food and nutrition insecurity is a gender related issue.

As it is often claimed, women literally 'feed the world' (Baden, 2013). Despite limited access to either local or global markets, women constitute the majority of food producers in the world and usually manage their families' nutritional needs (FAO, 2012). They achieve this despite entrenched gendered inequalities and increasing volatility of food prices. Yet their own food security and nutrition needs are being neglected at the household level, where discriminatory social and cultural norms prevail (FAO, 2014). Addressing these disparities can accelerate the productivity gains needed to meet food requirements (FAO, 1995). Klasen (2002) points out that customary and formal tenure system have marginalized women's rights.

Indeed, women produce more than 50% of food grown worldwide (Klasen, 2002). Nevertheless, they face major hurdles. For example, even when civil law allows women to inherit land, other factors can downplay such potential benefits. Evidence shows that in sub-Saharan Africa women are often denied formal ownership rights in favour of more limited user rights and even then often only with the consent of a male relative (FAO, 2013). Women also tend to be allocated poorer land than men (FAO, 1995). Some resettlement and irrigation projects have eroded women's rights to land by providing formal titles only to men. The resulting tenure insecurity makes women less likely to invest time and resources in land or adopt environmentally sustainable farming practices. Women are important as food producers, managers of natural resources, income earners and caretakers of household food security (FAO, 2014). Agricultural productivity has been said to increase by as much as 20 percent when women are given the same inputs as men (IFPRI, 2002).

In addition, it is observed that the proportion of income controlled by women has a positive influence on household caloric intake (Kennedy and Peters, 1992). When women have direct control over assets such as land and income, this increases their decision making power, resulting in increased food productivity to their families (Landesa, 2012). According to FAO, the numbers of female smallholders who can access to credit up to 10 per cent lower than male smallholders; ultimately, have limited access to resources and substantially reduces women's ability to invest in seeds, fertilizers or technology or adopt new agricultural techniques (FAO, 2009a).

Gender plays a key role in food production and distribution. At the household level, once a family collects its harvest, women distribute and allocate the food stock until the next harvest (FAO, 2009). Women often increase food availability from income they make from non-food crops on food, health, clothing and education for their children, hence improving the entire household's food security (World Bank, 2009; FAO, 2011b). Although men also play a crucial role in food production; they, however, face fewer constraints than women. Men are more likely to have access to productive resources such as land, credit and extension services. In cases of crop failure due to harsh climatic conditions, cultural traditions often make it easier for men to leave their farms in search of employment elsewhere, leaving women behind to struggle to feed their families and make ends meet.

In geographical terms, the role played by women in agriculture varies from region to region and from country to country (FAO, 2009). Women's participation in agroforestry is high in certain areas such as indigenous fruit and vegetable products and processing. For example, in Benin, 90 per cent of women collect nuts/fruits of the shea tree. In Cameroon, women and children collect the leaves of *Gnetum africanum*, which is used as a vegetable (Kiptot and Franzel, 2011). However, often products collected by women have little or no commercial value, whereas men reserve higher-value products for themselves. Roles vary, as do tasks, and in practice the divisions are blurred (Guendel, 2009). For example, a study in rural Kenya showed that men were responsible for building the granary and women were responsible for hand digging, harvesting and transporting the crops (FAO, 2014). In another example, women farmers in Ghana chose to cultivate yams and cassava over maize, traditionally a man's crop. This decision

was made because these crops require fewer external inputs and are cheaper to grow, not because they are 'women's crops' (Ibid).

Men and women often have complementary roles, sharing or dividing tasks in crop production. Where large scale farming is practiced, men are involved in mechanized agriculture whereas women are responsible for household food production. DAO (2012) argue that women's contributions to agricultural food production are often over looked because most of their work is unpaid labor on family farms and headed by men. In addition to the above, Kenya being a paternal society men are expected to play the role of the provider. However, women have made significant strides in terms of income earned from farming and economic employment in decisions on the utilization of household resources even without ownership of land (Agarwal, 1979).

2.6.2 Influence of age of household head on maize production

Age is a critical factor in food production, especially the age of the household head. A study carried out by FAO (2015) argues that the higher the age of the household head, the more stable the economy of the farm household, because older people have also relatively richer experiences of the social and physical environments as well as greater experience of farming activities (Hofferth, 2003). In terms of labour supply, the age of the household head has an impact on maize crop production in the sense that young people are labor providers either on on-farm or off-farm activities and are expected to cultivate large tracts of land as compared to old people (Von Braun, Hazell, Hoddinot and Babu, 2003). Subsistence farming is generally characterized by greater reliance on labour than commercial farming (Hofferth, 2003). In subsistence farming, households with larger labour supplies are better positioned to increase the productivity of their land (Chen, 1991). Availability of a relatively larger labour force can be an advantage to those households who strive to achieve food security, provided that the excess labour force is engaged in other income generating activities (Thomas and Leatherman, 1990). But old people have issues like huge family and low energy which affect maize production.

2.6.3 Influence of education level of household head on maize production

Education is a social capital which can impact on households' ability to improve maize crop production. It is a critical factor which influences maize production status of households (Kaloi, Tayebwa and Bashaasha, 2005). Educational attainment by the household head could lead to awareness of the possible advantages of modernizing agriculture by means of technological inputs; enable them to read instructions on farm inputs packages and diversification of household incomes which, in turn, would enhance households' food supply (Haile, Alemu and Kudhlande, 2005). Education also produces non-cognitive changes in attitudes, beliefs and habits (Bogale and Shimelis, 2009). Increasing literacy and numeracy may help farmers to acquire and understand information and to calculate appropriate input quantities in a modernizing or rapidly changing environment (Maxwell, 2008).

Beliefs and habits on new technology may lead to greater willingness to accept risk, adopt innovations, save for investment and generally to embrace maize crop production (Kirimi, Gitau and Olunga, 2013). Education enhances the ability to acquire new information through experience with new technology. That is, it may be a substitute for farm experience in agricultural production (Rosenzweig, 1995). A higher level of education attainment help household head to acquire more information and become better farmers (FAO, 2014). The levels of education is believed to influence the use of improved technology in agriculture and, hence, farm productivity. Education determines the level of opportunities e.g. available to improve livelihood strategies and enhance food security. It also affects the level of exposure to new ideas and managerial capacity in production and the perception of the household members on how to adopt and integrate innovations into the household's survival strategies (Bogale and Shimelis, 2009).

2.6.4 Role of agricultural extension on maize production

Agricultural extension officers occupy a strategic position in the agricultural production cycle (Anderson, 2007). They connect the farmers and research scientists and between farmers and policy makers (Paddy, 2003). A constant supply of timely and appropriate information to farmers, researchers, and policy makers assists in maize crop production. Providing information to research scientists without making it available to agricultural extension officers will negate desirable integration (FAO, 2005). In Kenya, the ratio of agricultural extension officers to

farmers is 1: 1, 200 which is against the expected ratio 1: 400. This has affected famers who don't get in to contact to the extension officers hence lack important information concerning farming (GoK, 2014).

Research and extension policy component include: yield improvement, disease and pest control, fertilizer use, agro forestry and agronomic practices, drought resistance and improved research-extension linkage (Oskam, 1995). Despite an elaborate research network across the country, linkage between research, extension and farmers is poor (GoK, 2005). More often than not, adoption of some technologies like use of chemical fertilizer use and agronomic practices is circumvented by poor resource base of farmers, poor adaptability of some of the technologies to local circumstances (GoK, 1986). To make matters worse, poor budgetary allocation to research and extension and laxity in delivery hinder implementation (GoK, 2011).

The extension system is a product of gradual evolution in extension management practices, and the entry of the private sector, non-governmental organizations (NGOs) and civil society players in response to changes in economic policies (Qamar, (2002).The changes have implications on how extension is managed, approaches and methods are applied, key stakeholders are coordinated and linked, and on the most optimal way of financing extension service in the country. Other extension service providers include NGOs, Community-Based and Faith-Based Organizations. The entry of these new players has helped fill the gap created by the reduced presence of public sector extension service (GoK, 2010).

The Implementation Framework for National Agricultural Extension Policy (NASEP) was prepared to provide guidance to all stakeholders involved in agricultural extension so that there is a harmonized approach in its implementation, monitoring and evaluation (MoA and Livestock Development, 2003). The success in the implementation of this policy is predicated on the commitment of all sector players: public and private sector service providers, farmers, fisher-folk, pastoralists, ranchers and development partners. Successful implementation of the policy will contribute towards improved transfer of technology and management for higher agricultural sector productivity, a key prerequisite to poverty reduction and enhanced nutrition and food security (NASEP, 2007).

2.6.5 Influence of land tenure on household maize production

In most African societies, land used for subsistence farming is not owned by individuals or by families, rather it is owned by the community (Kormawa, Okike, Okechukwu and Akande, 2003). Each family is allocated a section of land sufficient for producing the food needs of the family (Moyo, 2000). The relationships between land tenure, agricultural investment and production have been studied in Africa and there is ample evidence as a basis for the development of improved land policies in support of food security (Palmer, 2000). Land tenure issues that affect food security include manifestations of unequal distribution of land, sub-optimal utilization of land and insecure tenure (Amanor, 2003). Where the security of tenure is weak, livelihoods can be constrained (Place and Otsaka, 2001). Thus, tenure remains the key factor in improving land management practices (Kairaba, 2002). And, where land distribution structures are highly unequal, the negative food security trends are exacerbated (Quan, 2000). Given the importance of the rural sector in attaining food security and reducing poverty, there is recognition by policy-makers that a vibrant agricultural and rural sector, underpinned by land reform, will provide the catalyst for improving living standards in Africa (Kasanga, 2001).

The policy of community ownership of land is changing in some African countries to a system of private ownership (Stamm, 2000). Some people are in favor of this new system since it provides security for the families farming the land (Sikoyo, Ochieng, and Kameri-Mobte, 2002). However, other people prefer the traditional system since it guarantees that all families in the community have access to land (Submarian, 1996). A small proportion of farmers in Kuria own land with title deeds while still holding on and using communal land (DAO, 2013). The use of communal land and the resulting ownership pattern (in Kuria) is attributed to the large number of livestock owned by the members of the community who require land for communal grazing (GoK, 2006).

An important aspect to note is that farmers do invest more on land that they have secure rights over than in cases where land is communally owned and of lesser entitlement (Mose, Burger and Kuvyenhoven, 2007). A study carried out by Kormawa *et al.,* (2003) points out that when assured of their land holdings, farmers are willing to invest in that given land hence can adopt a given technology with ease. These translate to higher agricultural productivity.

2.6.6 Influence of household size on maize production

Besides several determinants addressed above, household size too has an influence on the amount of food production of a household. The significance of household size in agricultural food production hinges on the availability of labor for farm production, the total area cultivated to different crop enterprises, the amount of farm produce retained for domestic consumption and the marketable surplus (Oluwatayo, 2008).In farming activities, households with larger labour supplies are better positioned to increase the productivity of their land (Babatunde *et al.*, 2007). Availability of a relatively larger labour force, regardless of farm size, can be an advantage to those households who strive to achieve food security, provided that the excess labour force is engaged in other income generating activities (Jiggins, 1986).The higher the household size the higher the dependency ratio on food demand and consumption in a household (Lugairi, 2004; Sikwela, 2008) has also shown the probability of food security decreases with increase in household's size. An increase of a household means more people to feed and indirectly reduces income per head, expenditure per head and per capita food consumption (Paddy, 2003).

2.6.7 Influence of farm size on maize production

Household farm size is one other factor that has an influence on household food security (Haile, Alemu and Kudhlande, 2005). Farm size positively and significantly relates to the probability of household being secure. Majority of land size owned by households in Kuria East sub-County are small and used for subsistence farming (DAO, 2013). The average farm size for small scale is three acres while large scale farm size is seven acres (GoK, 2012). Small parcels of land for food production attributable to competition from tobacco and sugarcane whose incomes hardly benefit women and children has reduced accessibility to food (GoK, 2014). The sample household plant food on farmlands of different sizes after giving the best agricultural land for tobacco production, with little remaining land for food crop production. The inequitable distribution of land under cash crop and food production has contributed to the declining state of food in the study area (DAO, 2013). Maize production would be increased through expansion of areas under cultivation (Van Der Veer and Tagel 2011). With large farm sizes households can produce more and also diversify. According to Haile, Alemu and Kudhlande (2005) maize production can be increased extensively through expansion of areas under cultivation.

2.6.8 Effects of income level of household head on maize production

Employment in off-farm and non-farm activities are essential for diversification of the sources of farm households' livelihoods; it enables households to modernize their production by giving them an opportunity to purchase the necessary inputs, and reduces the risk of food shortage during periods of unexpected crop failures through food purchases (FAO, 1999). Especially in Africa, diversification of sources of income has long been a survival strategy which allows household heads to reduce the risk of starvation for themselves and their families during periods of chronic or transitory food insecurity (Devereux, 1993; Maxwell and Frankenburger, 1992). According to DAO (2012) households diversify their incomes by selling firewood, charcoal, crafts (*jikos*, cooking sticks, pots and baskets) and working on farms as daily labourers.

2.7 Farmers' Perceptions of environmental factors as determinants of maize production

Perception is the way smallholder farmers think and behave in relation to climate variability and change which is characterized by extremes of temperatures and rainfall that ultimatelybringaboutfrequentfloodswhichoftenalternatewithdroughts (Adger, 2003). These effects have a direct impact on smallholder farmers, who mostly rely on rain-fed agriculture for their domestic food production. Most of the farming households have limited means of coping with this adverse weather variability (FAO, 2012). Climatic instability negatively affects agricultural productivity leading to substitution through importation or a shift to other sectors (Wehbe, Eakin, Seiler, Vinocour, Avila and Marutto, 2006). The degree to which households are able to and do respond to a specific climatic threat is determined by their perception of the threat as well as the relative importance they place on climatic risk compared to other sources of stress and the range of choice and opportunity they have been given by the particular socio-economic conditions in which they live (Ibid). Farmers make decisions based on what they think is likely to occur, and sometimes based on what they fear, or hope is possible which explains differences in behavior among farmers (Legesse and Drake, 2005; Patt, 2001). Farmers' perception of environmental factors, income, and investment decisions are rarely made in response to a single stressor such as drought risk, but rather the outcome of a process of considering simultaneously a wide variety of stressors are limited to climatic factors (Jennings and Magrath, 2009).

Farmers' perception of environmental factors are among key elements influencing maize production (Smithers and Smit, 2009). Most agricultural food production in sub-Sahara Africa is

rain fed; thus it is vulnerable to vagaries of weather. At the same time, soil fertility is affected by over cultivation of a farm, land degradation and loss of top soil which are on the rise reducing agricultural yield in sub-Saharan Africa (Barrios *et al*., 2008). However, majority of the farmers from sub-humid region attributed the perceived changes in rainfall to be low and erratic. It is the major factors contributing to perceived changes in agricultural practices (FAO, 2012). IFPRI (2009) points out factors such as temperature, precipitation (rainfall) and soil as key drivers affecting agriculture. Environmental factors mainly include; temperature, rainfall and soil can greatly impact on food production (Saber, 2009). High variability in rainfall occurrence and amounts create severe constraints for crop growth and yields because rainfall is one of the most critical factors for ecological and environmental processes. In rain-fed agriculture, the amount of water available to plants strongly depends on the onset, length, and end of the rains (Ati, Stigter and Oladipo, 2002). Rainfall variability and adaptation mechanisms on smallholder famers affect agricultural production depending on rainfall received during OND (short rains) and MAM (long rains) season and this can result to either crop failure or low crop yields (Ochieng', 2013)

Rainfall is the primary factor affecting maize crop production in rain-fed agriculture (Godwin, 1990). According to the research carried out in Zimbabwe by Elwell (1994), there is a linear relationship between rainfall amount and yield on granitic sands and high rainfall conditions of where yield increased proportionally to rainfall amount. The soil type also influences the type of crop production. The crop production potential of granitic sandy soils is low, but if adequate fertilizers are applied, average yields can be achieved (Moyo, 2003). However, the fertilizer application is very much dependent on rainfall, so that rainfall availability and distribution becomes the most important factor influencing crop production (Moyo, Robinson, Katerere, Stevenson and Gombo, 1991).

2.7.1 Effects of climate variability and change on maize production

Farmers perceive climate change differently and their perception of climate variables is key for rain-fed agriculture since farmers cope with climate change based on their perceptions of changing climate patterns (Seitz and Nyangena, 2009). Maize crop production is sensitive to climate variability and change which vary from year to year (IFPRI, 2009). Most maize crop varieties relies heavily on predictable rainfall and temperature which end up affecting the

livelihoods who rely on rain-fed agriculture (Kabuko-Mariara and Karanja, 2007). Climate change has negatively impacted on agricultural maize production since many countries in Africa rely on rainfall agriculture. Kenya is already apparent in the changing precipitation patterns and more frequent and erratic extreme events of drought (Bancy, 2000). Rain-fed smallholder farmers in Kenya are most vulnerable groups to climate change and rainfall variability which has made maize production to lag behind (IPCC, 2007). Households in Kura East sub-County are largely small scale farmers, and they focus on growing maize as their staple food (GoK, 2008-2012). These smallholder households already operate under pressure from food insecurity caused by climate variability and change. The households thus practice subsistence agriculture which is already vulnerable to effects of rainfall variability (Irungu, Ndirangu and Omiti, 2009).

2.7.2 Influence of soil fertility on maize production

Soil fertility is the ability of soil to function within natural or managed ecosystem boundaries to sustain plant and animal productivity (Sheahan *et al.,* 2014). Maize crop production is affected by soil fertility of a given farming land, particularly due to soil fertility depletion that may be caused by continuous farming and soil erosion which are serious constraints to maize productivity (FAO, 2013). Intensive farming often leads to vicious cycle of exhaustion of soil fertility and decline of maize production yield (Barrett, 2006). Soil infertility have been identified as a major constraint

in producing adequate maize to feed the world's escalating population (Pimentel, 2006). Moreover, soil erosion has been a major threat to soil fertility since the beginning of agriculture. Slash, burn and tillage before or after planting have led to soil erosion. This has affected many parts of Kenya including Kegonga (DAO, 2011). Some parts of Kegonga have deep soils while others thin soils, especially areas around rocks (granitic tors).The perception of farmers concerning soil quality is measured by the fertility of soil and the type of weeds growing in a given farm land. Under optimal management, better soil quality boosts maize crop production (Berazneva *et al.,* 2016). Stephen (2000) found that a decline in soil fertility negatively affects maize production.

2.8 Influence of Other Agricultural land use Practices on food production

Among the major factors influencing maize crop production in the study area; there are other factors affecting production of maize crop. This include; tobacco farming, government policy

and political influence. Tobacco as the main cash has a higher impact on food security in that the cash received from cash crop tobacco may be used to purchase maize during food shortage (GoK, 2012).

2.8.1 Tobacco farming and maize production

Tobacco is a cash crop that has been produced in Kenya for the last 40 years. Since its introduction by the British-American Tobacco (BAT) multinational, its culture, use, health and economic implications have become issues of social and academic inquiry. Chacha (1999) further notes that tobacco is well known to be destructive, not only to the soil, but also to the forest resources. Growing concerns have been expressed not only about the health hazards involved in tobacco production, but also about the environmental unsustainability of the crop in terms of excessive use of wood (Geist, 1997). Today, the crop poses a particularly difficult dilemma for development since its production has generated a wide range of employment, income, foreign exchange and other cash-contributing effects, while the damage to forest resources and to the environment in general seems to outweigh the benefits (Chacha, 1999).

Globally, 5.3 million hectares of arable land are currently under tobacco cultivation; land that could feed 10 –20 million people (Makoye, 2012). In 2009, six of the top ten tobacco-producing countries had undernourishment rates between 5% and 27%. In many countries, such as Sri Lanka, thousands of farmers have replaced traditional food crops with tobacco, due to its commercial profitability (McLaren, 2007). In Zimbabwe tobacco is highly profitable cash crop for both large and small scale farmers, generating direct and indirect (wage) income for smallholder farmers (Price Waterhouse Coopers, 2001). In Kenya, tobacco is a cash crop that contributed to the development of tobacco farmers, and by extension that of the entire country. Further, studies have shown that the returns from tobacco growing are not commensurate with the time and effort required, and is much less than alternative crops grown in the country (KNBS, 2012).

As a country, Kenya has made steps to mitigate the negative effects of tobacco. Several legal mechanisms have been put in place to ensure implementation of the mitigations. Key among

these laws is the Bill of Rights provided by the Constitution of Kenya, 2010 and the Tobacco Control Act,

2007 (Oongo, 2007). In tobacco growing areas, there are a number of negative effects of tobacco. Tobacco growing is highly labour intensive and requires a lot of resources and land. Growing tobacco leaves very little space for other food crops needed by the families in the tobacco growing areas (Salojee, 2007). This in effect has led to famine being experienced in tobacco growing areas. In addition, the earnings for tobacco are very low compared to the inputs. Furthermore, child labour and school drop-outs are common features in the tobacco growing areas. The curing of tobacco itself has also led to deforestation, soil erosion and other environmental hazards. The curing plants (barns) have exposed farmers to tobacco smoke thus increasing chances of suffering from tobacco related diseases (Beyer and Brigden, 2003)

2.8.2 Government Food Policy and its Influence on Maize Production

A policy plan, directed towards combating food insecurity, ascribes political interest and interference into all aspects of food, starting from production, distribution to creating food availability for all (GoK, 2011). The government of Kenya by implementing such strategies aims to increase food availability and accessibility, as a main pillar in increasing economic development and improving overall food security in Kenya (Kilonzi, 2013). It is stated in the Kenyan Constitution that national security in Kenya includes the protection of Kenyan population, their rights and freedoms, stability, peace and other national interests. Thus, the right to be free from hunger is among the rights protected by the Constitution (GoK, 2011; Glopolis, 2013). The first National Food Policy was introduced in the 1981. It sought to sustain self-reliance in food and guarantee fair food and nutrients distribution among the Kenyan population. The government was to play the main role in accomplishing these targets.

The National Food Policy of 1981, set up guidelines for decision making on all major issues related to food production and distribution including marketing, trade, pricing, research and extension, agricultural credit, inputs, land use, food security and nutrition (GoK, 1981). The trust of food security policy was to increase production and distribution of food to all areas and accumulation of a multi-commodity strategic food reserves from domestic surplus for use during periods of crop failure (Ibid)

Food policy involves food production, processing, distribution, and purchasing; with the support of international agencies, adopting various policy measures to improve food security (USAID, 1992). For centuries, governments have worked towards ensuring food availability to their constituents. Bongaart and Bruce (1998), point out that; various government policies have been introduced to influence the amount of food available to Kenyan population and to tackle hunger and food security (Maina, Newsham and Okoti, 2013). Food policies are designed to influence the operation of the food and agriculture system. The policy consists of a set of goals for food production, processing, marketing, availability, access, utilization and consumption, and describes the processes for achieving these goals (GoK, 2011). Food policy can be applied at any level, from local to global, and by a government agency, business, or organization (Maxwell and Simon, 2012).

In addition to the right to be free from hunger, there are three main objectives for food policy: to protect the poor from crises, to develop long-run markets that enhance efficient resource use, and to increase food production that will in turn promote and increase in income (Timmer and Peter, 1983). Food policy comprises the mechanisms by which food-related matters are addressed or administered by governments, including international bodies or networks, and by public institutions or private organizations.

Other causes of food insecurity include; application of inappropriate policies, which result in disincentives to local production and efficient marketing (FAO, 2005). Often local farmers have no incentive to invest in sound agricultural or environmental practices because of price controls, insecure land tenure and/or overly centralized government structures, which stifle local initiative. Private food distribution may be discouraged by excessive regulations and by unfair competition from subsidized and inefficient government-run parastatals (Nyangito, 1999).

Katz (2002), points out that, there is no impartial institution to inspect production and marketing of maize and as such limits the private sectors' engagement or investment in food production. Under extension: there are recognized weaknesses in extension approaches, which have limited the use of improved maize technologies by farmers. Under input pricing and marketing, there are poor information flows to farmers on appropriateness and levels of use of improved inputs.

Following liberalization, high cost of inputs have made them inaccessible to farmers (FAO, 2005). Low maize pricing and marketing have led to unstable domestic prices, which have in turn lowered production and access to maize by consumers. Further, support from the government to private sector to develop and improve efficiency in maize production is inadequate. Limited private–public sector partnership has also hampered the achievement of food security (Jayne, 1997).

Jayne, Mather and Mghenyi (2010) reported that in 2010 maize crop was affected in Kenya by the scarcity of agricultural inputs. Increase in agricultural input prices in general increased after implementation of market liberalization policies. Although market liberalization policies had an objective of increasing the general productivity and efficiency in production, they have contributed to a decline in food production in Kenya (Mbithi, 2000). This is because the policies were mainly price oriented (output and input pricing), and did not consider non-price factors such as the institutional framework and infrastructure. Increase in real maize producer prices during the market liberalization policies did not offer enough incentives to maize farmers to produce more because price is not the only factor attaining maize profitability (FAO, 2008).

Kenya's trade policy originally was based on the need to safeguard the local agriculture and domestic manufacturing sector against adverse competition. Instead the trade regime tended to unfairly tax agricultural exports thus denying the country of vital foreign exchange with which it could access food imports (Nyangito, 1999). Even after the trade regime was liberalized, cheap food imports have suppressed domestic food prices and therefore food production competing uses for land have tended to reduce the land area dedicated to food farming.

The Kenyan government has under invested in infrastructure that could be vital to encouraging cross border trade in food commodities, which can reduce food insecurity (Ackello-Ogutu and Echessah, 1997). Until recently the high tariff regime on intra-regional trade reduced the potential of regional trade to help in alleviating food insecurity through food imports from the region (Mwale, 1997).

2.8.3 Influence of political instability on Maize Production

The agricultural sector is the backbone of Kenya's economy and the means of livelihood for most of our rural population. Sustained agricultural growth is critical to uplifting the living standards as well as generating rapid economic growth (GoK, 2010). Civil wars and armed conflicts have been associated with food insecurity in the developing world (FAO, 2003b). The impact of war, especially on the rural economy and the rural environment is very destructive (WHO, 2009). Some of the negative impacts include: disruption of production, loss of local genetic resource stocks, and erosion of natural resources (Taeb, 2004). Internal conflicts in Africa have brought the disruption of agricultural activity in many rural areas. Conflict in Ethiopia, Mozambique, Somalia, Sudan and Rwanda can be cited as examples where millions of people have been exposed to famine mainly because of armed conflict (White, 2005).

In 2006 Mount Elgon residents faced conflicts that saw them flee their homes and this had devastating effects on the food security (FAO, 2010). Conflict also affects food security indirectly by distracting infrastructures such as roads, bridges and houses (FAO, 2006). Main and feeder roads improve access to necessary input fertilizer, seed, pesticide chemicals and other agricultural implements are very indispensable (Osman and Tesfahuna, 2003).

Food insecurity and famine are evident in areas where war and armed conflicts are prevalent (FAO, 2003b). In case of forced conscription of young men into the army disrupts the productive capacities of rural households (FAO, 2006). Food production in tribal clashes hit areas in 1992-1993 including Nakuru, Bungoma, Uasin Gishu and Narok districts declined. This made food security vulnerability to increase in the areas which were not considered to be chronically vulnerable (FEWS, 1995). Northern and Eastern regions of Kenya were characterized by local conflicts and this restricted the movement of vulnerable communities towards better grazing and water. Kuria East Sub-County is one of the areas being hit by intra-tribal clashes occasionally (DAO, 2012).

2.9 Theoretical Framework

The Sustainable Livelihoods Approach (SLP). (Figure 2.1) was central to this study. The framework provided an important insight and a strong starting point to understanding the dynamics of Kuria livelihoods as it places emphasis on ownership of, or access to, assets. SLAF

focuses on sustainability, productivity and people's livelihoods. 'Sustainable Livelihoods Approach' looks at people's situation, needs and interests (Chambers, 1983). The livelihood approach has been modified and given different interpretations by various authors and organizations (Cahn, 2002; DFID, 1999; Ellis, 2000; Scoones, 1998). Two widely used definitions of livelihoods are: assets (including both material and social resources) and activities required for generating a means of living. A livelihood is sustainable when it can cope with, and recover from, stresses and shocks maintain or enhance its capabilities and assets, while not undermining the natural resource base (Scoones, 1998).

The SLA defined livelihood assets as composed of human (H), financial (F), physical (P) and social (S) capital assets. All these assets have an influence on food production either household or community level (Ellis, 2000). The International Institute for Sustainable Development (IISD) (2003), points out two major dimensions, which are essential for rural livelihoods, namely the environment or ecology, and the social dimension. The former is concerned with the sustainability of the food resource base, on which most rural livelihoods rely. According to Scoones (1998), some authors define the environment dimension as "the ability of a system to maintain productivity when subject to disturbing forces, be it stress or shock" and social dimension as relating to livelihood adaptation, vulnerability and resilience, and the ability of a livelihood to cope with and recover from stresses and shocks.

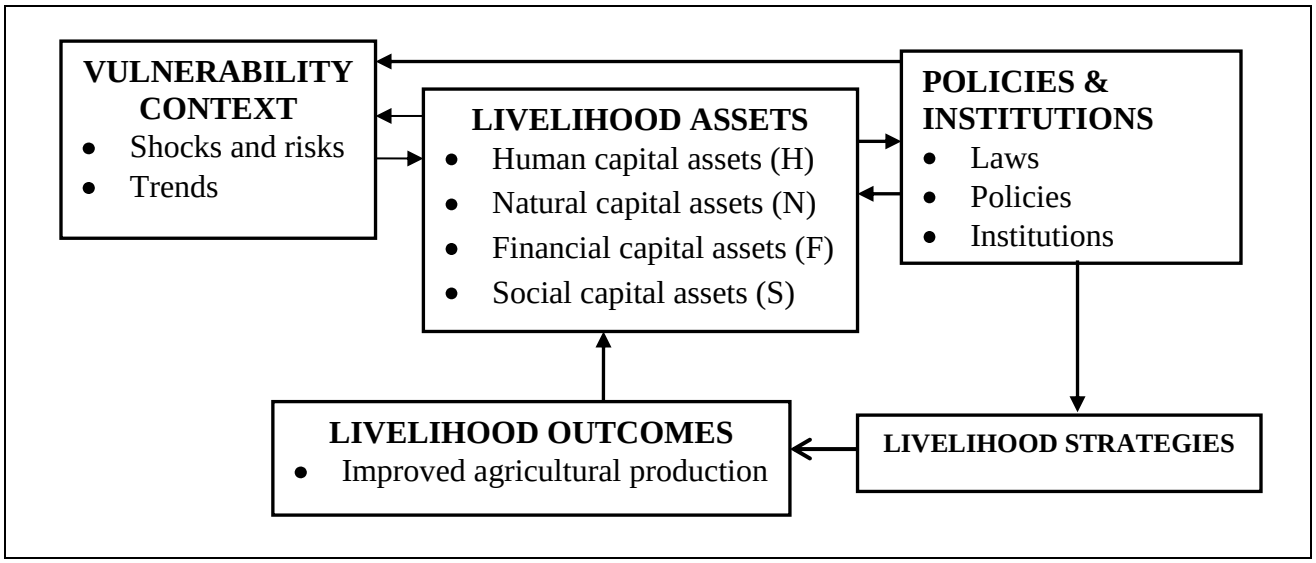


Figure 2.1: The Sustainable Livelihoods Approach Framework (SLAF)

Source: DFID, 1999

The SLAF provided a linkage between the study objectives and research questions. The shocks include drought and hunger. Trends in natural and socio-economic processes directly influence food production. These trends include: Rainfall variability and soil fertility. The SLAF was useful in understanding that various capitals play a major role in adoption of the mitigation measures during food deficit and socio-economic factors affecting food production. It defines Human capital as a function of knowledge, which include; education level and the age of the household head.

Natural capital is the level of diversity in an environment, this include land size and land tenure. Financial capital refers to stocks. These include maize production and the income level of the household head. Social capital involves the formal and informal networks, groups and institutions. Formal social institutions include agricultural advisory services, government and NGO assistance during times of drought or hunger. Informal institutions comprise the practice of borrowing food from friends, relatives and other farmers during food shortages. This approach also suggests that livelihood is shaped by policies of government, NGO and developmental agencies institutions and decision making process from the household to international level. This study benefited from the SLAF, as it provides a multi-facet approach to the factors (shocks) influencing maize production. It assisted in understanding the shock and stress affecting farming households' food production and implication to food security, what is required for the small scale farmers to overcome barriers of food production. From SLAF, livelihood outcome is affected by both environment and socio-economic factors.

2.9.1 Gaps in the Literature Reviewed

Studies reviewed on maize crop production do not provide sufficient understanding on environmental and household level factors affecting production of the crop. Furthermore, the existing literature on maize crop production is scanty. Much of the attention is paid to the global and national point of view (FAO, 2014). Moreover, little attention has been given to the role of other agricultural land use practices and its influence on maize production at household level. Thus, this study has attempted to fill the knowledge gap by analyzing rainfall data (long and short rains) in relation to maize production data between 2010-2014, farmers' perception of environmental and socio-economic factors influencing maize crop production at household level in Kuria east sub-County.

2.9.2 Conceptual Framework

The conceptual framework (Figure 2.2) adopted for this study was derived from the literature review. It defines the dependent, intervening and independent variables that provide guidelines on how to undertake the study and indicate that perception of farmers on environmental and household level factors affecting maize production.

From Figure 2.2, we observe that maize crop production is influenced by environmental, household and individual level factors. Among the environmental factors are rainfall variability and soil fertility. Maize production depends mainly on rainfall received; number of rainy days, onset and cessations and therefore any variation on the key indicators of rainfall variability affect maize crop yields. Other agricultural land use practices act as a source of income in assisting households to buy food during periods of food shortage. Land tenure affects food security via unequal distribution of land, sub-optimal utilization of land and insecure tenure (Amanor, 2003). Where the security of tenure is weak, livelihoods can be constrained (Place and Otsaka, 2001). Maize production depends mainly on household level factors such as; gender, customary and formal tenure system have marginalized women's rights, yet woman play a bigger role in maize production than men worldwide (Klasen, 2002). Age of the household head, size of the household, and education level are other critical factors affecting maize production. Hofferth (2003) argues that the higher the age of the household head, the more experience of farming activities they have. Education of the household head is a social capital which has an impact on household's ability to improve on maize production (Haile, Alemu and Kudhlande, 2005).

Besides several determinants addressed above, the intervening variables: government policy, prices of farm inputs, marketing, political instability and extension services have an influence on both independent and dependent variables resulting to either increase or decrease of maize production.

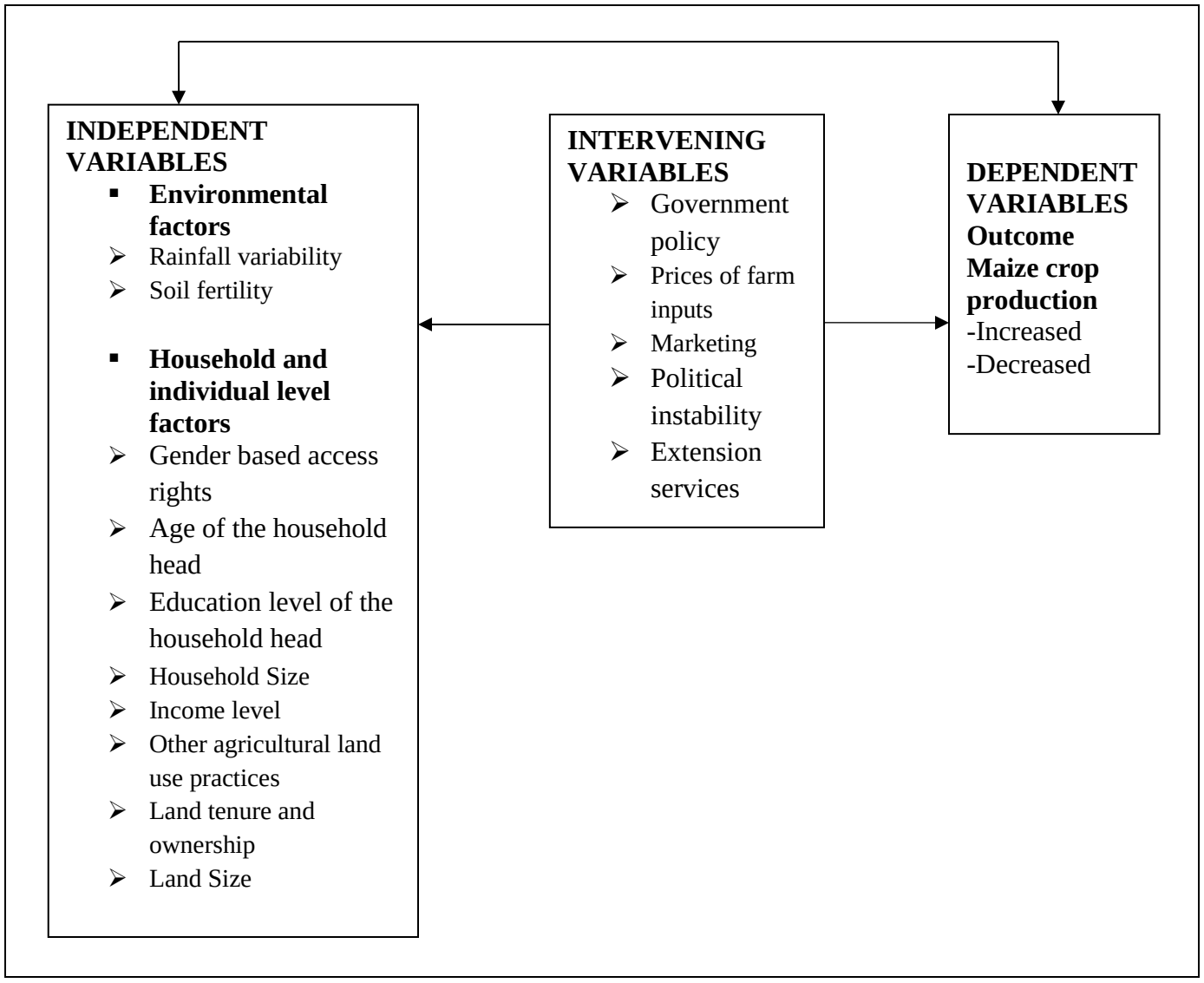


Figure 2.2: Conceptual framework; derived from synthesis of literature reviewed.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This section outlines the methodology used to realize the objectives of the study. It presents the description of the study area, the research design, the population of the study area, sampling procedure, data collection and analysis.

3.2 Description of the Study Area

The study was conducted in Kuria East sub-County which lies in the latitude of 0°15' north and 1°45' south and longitudes of 35°15' East and 34° West, situated in Migori County, southern part of Nyanza Region (Figure 3.2).

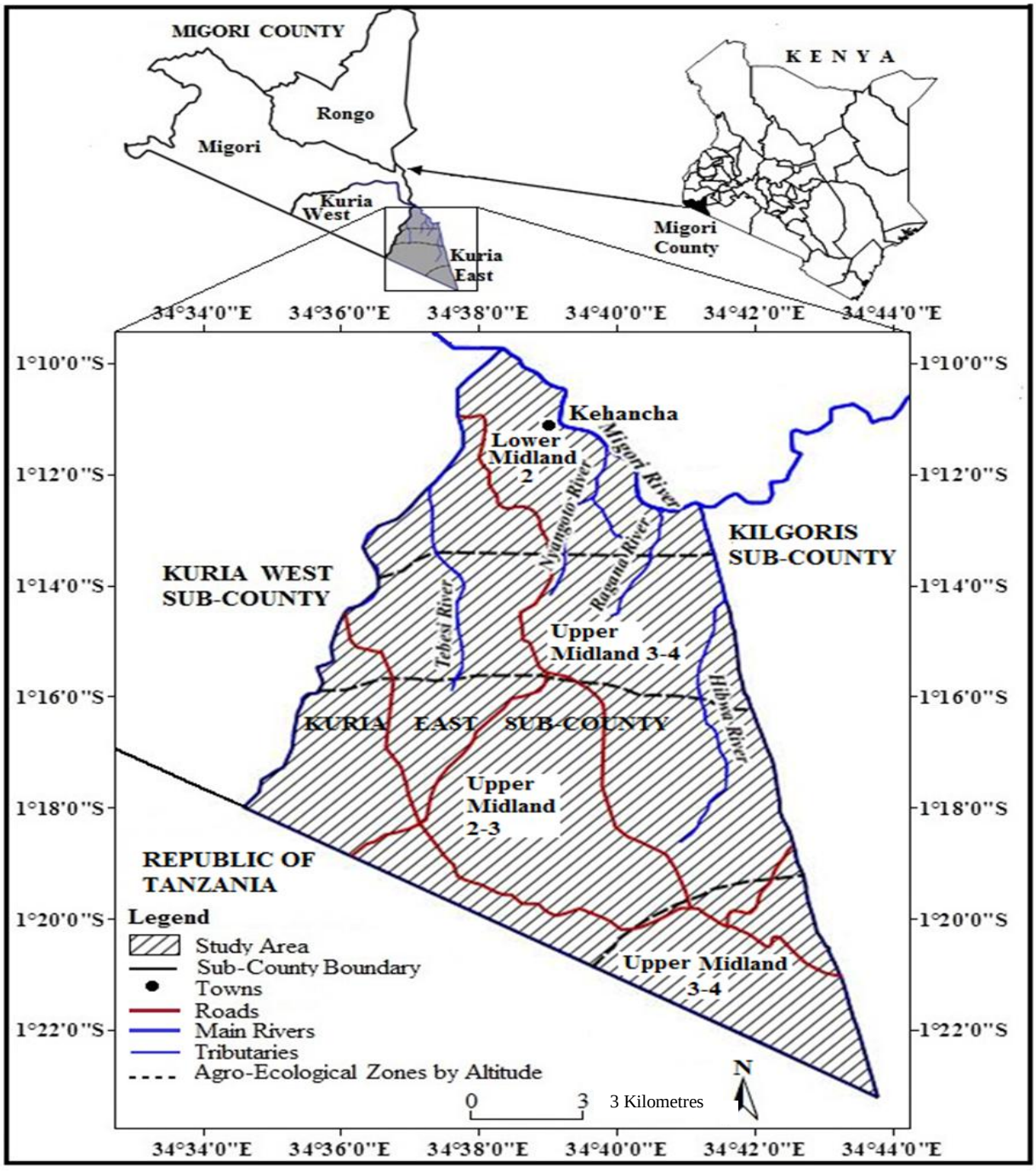
3.2.1 Population Size

Kuria East sub-County covers an area of 188 square kilometres with a population density of 435 persons per square kilometre. According to the 2009 Population Census Report, the sub-County had a total population of 81, 833 comprising of 40,248 males (49.2%) and 41,585 females (50.8%). The population was projected to grow to 126,337 by 2017 (GoK, 2008-2012). According to GoK 2009 the density of the study area was 435 persons per square kilometre (GoK, 2009).

3.2.2 Physical Background

Kuria East sub-County is characterised by undulating hills interspaced with a few stretches of flat land with altitude varying between 1400 metres-1887 metres above sea level. (GoK, 2008-2012).The sub-County has a rugged terrain and high surface run off making road maintenance and construction difficulty and costly Topographically, the undulating hills are intersected by river valleys which run from the south towards the north interspersed with few stretches of flat areas.

The main rivers in the sub-County are Hibwa, Ragana, Nyangoto and Tebesi, all of which originate from the higher rainfall region of the Republic of Tanzania, and transverse the sub-County to join River Migori as indicated by Figure 3.1. Often when there is heavy rainfall, all the rivers over flow and cause havoc in the lower parts of the sub-County. There is no lake in this sub County but there are quite a number of man-made dams distributed in the divisions. These provide significant amounts of water for domestic use.



S

Figure 3.1: Map showing Physical Features and Agro-Ecological Zones in the study area.

Source: Farm Management Handbook of Kenya, Volume II, Part II/A (West Kenya) Subpart A2 (Nyanza Province) and Survey of Kenya, Topographic Sheet No. SA-36-8 (Narok), 1976.

3.2.3 Climatic Conditions

The study area has a modified tropical equatorial climate type. The climate is modified by the effect of relief which ranges between 1400 metres and 1887 metres above sea level, due to the influence of Lake Victoria; the division receives bi-modal rainfall with peaks in April and November. Dry seasons occur in the months of December, February and in September. Annual rainfall averages between 1500 mm and 2600mm. Temperatures are generally warm and rarely fall below 18^{o}C. Annual temperatures range between 27^{o}C and 31^{o}C. The climate is suitable for various crops such as maize, coffee, tobacco and horticultural crops (GoK, 2008-2012).

3.2.4 Soils

The major soils found in the sub-County are volcanic and clay-to-clay loam soils. The other types of soil are silt, loam, nitrohumic ferrasols, and nitrohumic ferrasols planosols. Volcanic soils are deep and well drained are found to the south of Ntimaru Division while nitrohumic ferrasols are found both in Kegonga and Ntimaru Divisions. Poorly drained planosols are found in valley bottoms. Regosols and lithosols are found around rock outcrops and may also occur on hill tops (GoK, 2008-2012). In the former South Nyanza Province where Kuria East sub-County falls there are some patches of phaeozems soils which are well drained, less weathered clayed soils with high organic contents of organic humic substance in top soil (Jätzold and Schmidt, 1982).

3.2.5 Agro ecological Zones

On the basis of land use, the sub-County is divided into three zones, namely; Upper Midlands (UM_2, UM_3) and Lower Midlands (LM_4).UM_2 and UM_3 are characterised by small farm sizes and used for intensive agricultural activity; whereas UM_4 is more suitable for livestock production (Figure 3.1). According to GoK (2008-2012) the potential of the land has, however, not been fully exploited since only about 61.53 percent of all arable land (15,926 Ha) is under crop cultivation. The remaining 38.47 per cent is put under grazing and forests. Farming is mainly under small scale.

3.2.6 Economic Activities

The agriculture sub-sector forms the backbone of the economy of Kuria East sub-County. The main economic activity in Kegonga and Ntimaru divisions is farming, where tobacco, maize, beans, and sweet potatoes are the main crops (GoK, 2008-2012).

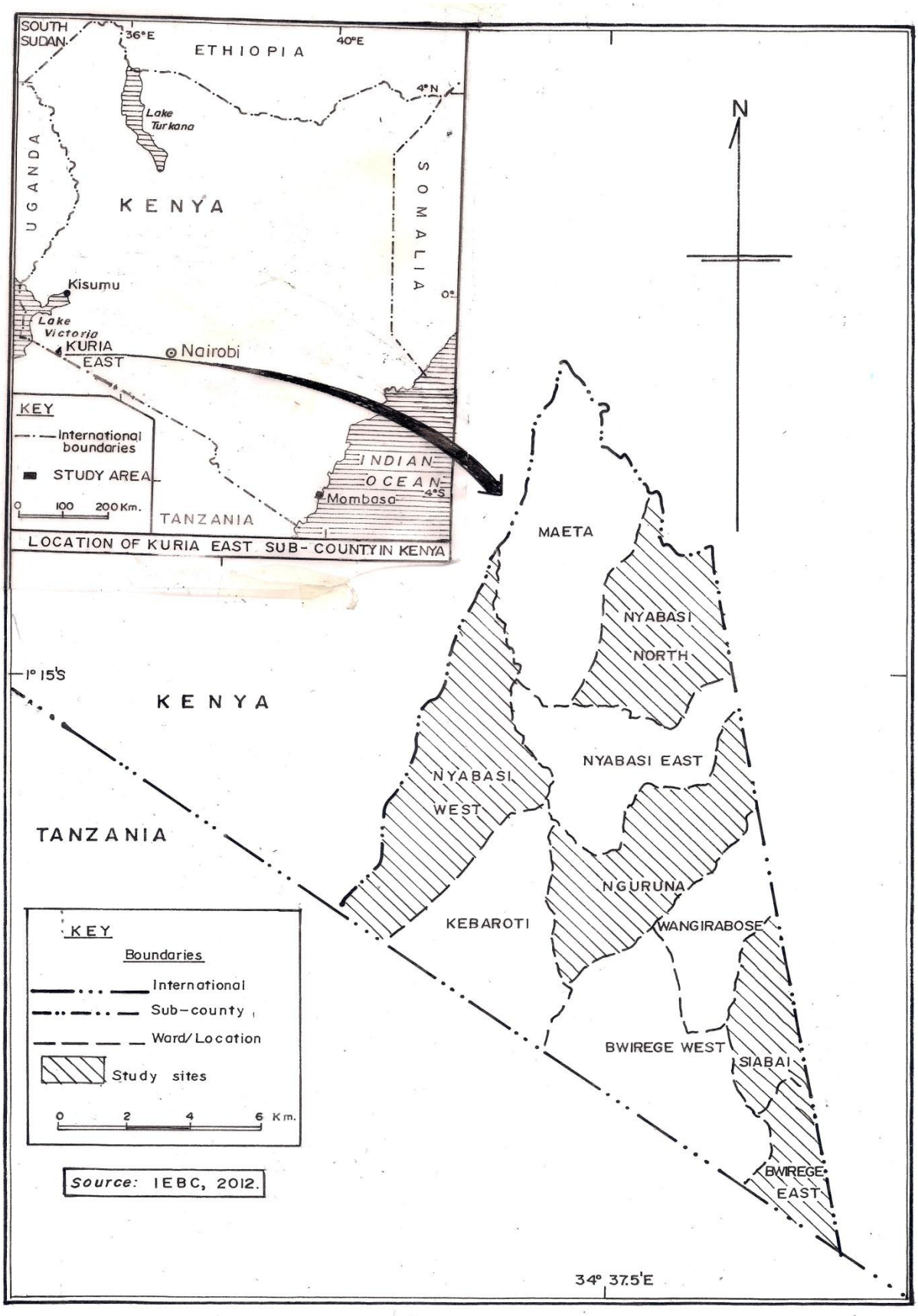


Figure 3.2: Map of the Study Area

3.3 Research Design

This study was based on a cross-sectional household survey research design. In survey research; the researcher selects a sample of respondents from a given population for detailed study. With this design, large samples are feasible and many questions can be asked about a given topic giving considerable flexibility of analysis. The sampling frame consisted of 316 households derived from the nine sub-locations in the study area that acted as clusters (Table 3.1).

3.3.1 Sampling design, sampling frame and sample size

Data collection was carried out by use of both probability and non-probability sampling procedure to acquire the necessary data for the study. A sample size of 316 was selected for the study. This represents 5% of 6,024 households in Kegonga and Ntimaru divisions.

3.3.2 Probability sampling procedure

Probability sampling method was used to select the sample household heads. This sampling procedure has the advantage of giving all elements in the universe (in this case all farming households in the study area) an equal and independent chance of being included in a sample (Nachmias and Frankfort-Nachmias, 1996). It also provides an efficient system of capturing a small group and variations that exist in the target population. Systematic sampling technique was then employed for the selection of households from each stratum as shown in Table 3.1.

Table 3.1: Number of households in each sub-location and sample size

Locations	Sub-location	Number of Households	Sample size per sub-location	sample size
Nyabasi	Nyamagenga	632	632/6024×316	33
North	Kugitimo	471	471/6024×316	24
	Girigiri	442	442/6024×316	23
Nyabasi	Getongoroma	461	461/6024×316	24
West	Nyabikongori	1,181	1181/6024×316	61
	Nyaroha	533	533/6024×316	27
Bwirege	Gwitembe	770	770/6024×316	40
East	Masangora	554	554/6024×316	33
Siabai	Siabai	980	980/6024×316	51
	Total	**6,024**		**316**

Source: KNBS, 2013

Multi-stage simple random sampling was used to select respondent households in Kegonga and Ntimaru divisions; this sampling technique allow sampling to be done in stages using smaller sampling units at each stage.

3.3.3 Target Population

The target population for the study consisted of 6,024 households (Table 3.1) in Kuria East sub-County (GoK, Census 2009). The study targeted household heads since they were the ones who make decisions on their farms. The household heads were involved in crop production and deemed suitable to provide relevant information about farming practices in their farm. Sample size was calculated as follows:

Confidence level: 95 %

Confidence interval: 5 %

Sample size: 316

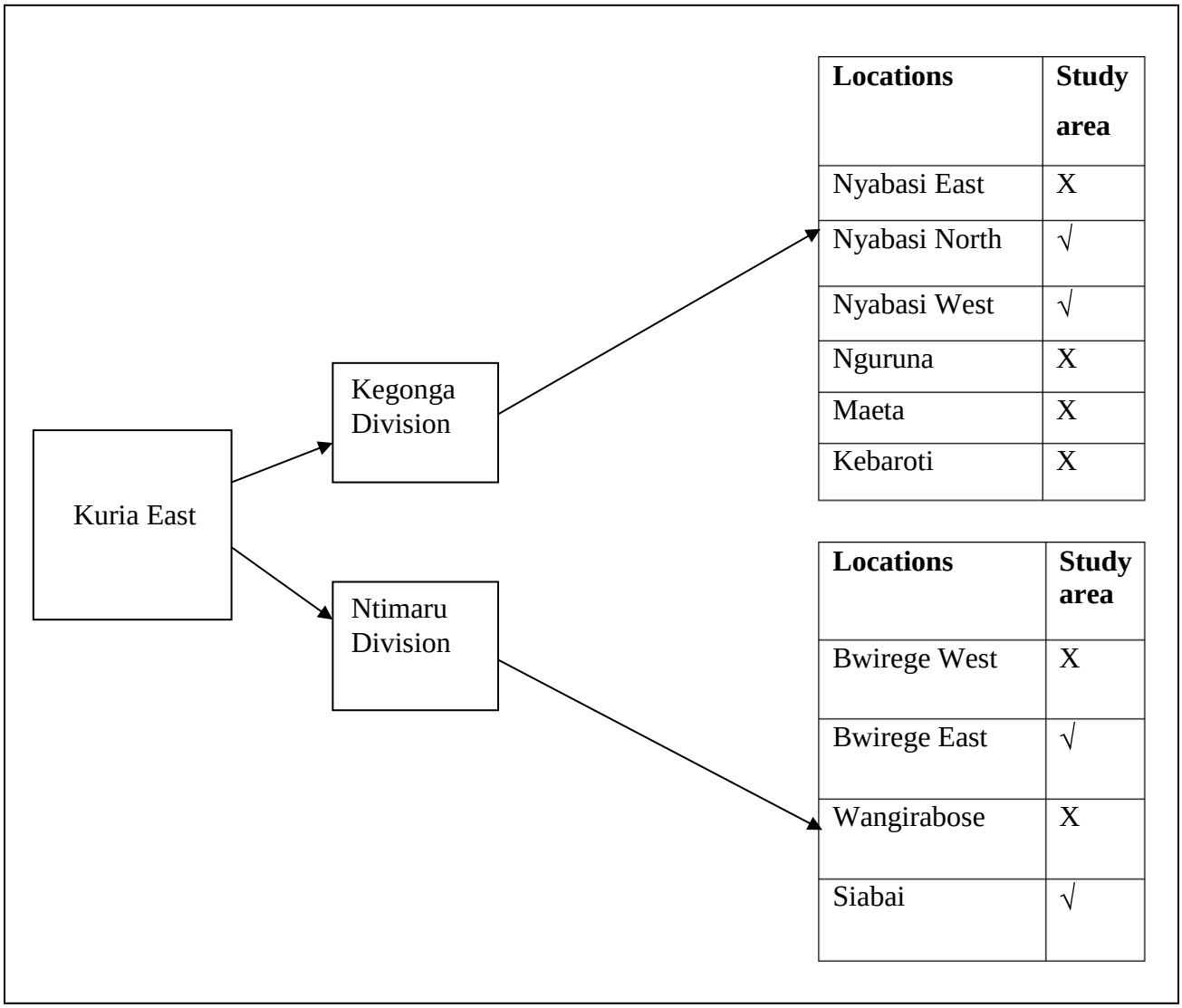
Population size: 6,024

Sample size = 5%/95%×6024=316

The sample size was 316

3.3.4 Stage one of multistage sampling

The first stage of sampling involved selecting the four administrative locations in the study area. This was done by assigning numbers to the 10 locations in the two divisions on small pieces of papers, rolling them, placing the rolled pieces of paper in a container, mixing them thoroughly, and followed by picking the sample locations randomly: Nyabasi North (Nyamagenga, Kugitimo and Girigiri); Nyabasi West (Getongoroma, Nyabikongori and Nyaroha); Bwirege East (Gwitembe and Masangora) and Siabai (Siabai sub-location).



Locations	Study area
Nyabasi East	X
Nyabasi North	√
Nyabasi West	√
Nguruna	X
Maeta	X
Kebaroti	X

Locations	Study area
Bwirege West	X
Bwirege East	√
Wangirabose	X
Siabai	√

Figure 3.2: Stage 1 of multistage sampling

X - Unselected area for study
√ - Selected area for study

3.3.5 Stage two of Multi-stage sampling

This stage of sampling involved listing of all the households in the nine sub-locations. According to Kenya Bureau of Statistics Population Census 2009, the study area has 6,024 households in the nine sub-locations (Table 3.1). This represents 5% of the 6,024 households in Kegonga and Ntimaru Divisions. This sample size was considered appropriate because the population under study exhibits fairly homogenous socio-economic characteristics. This sample size was calculated as follows;

Finding out sample size

Confidence level: 95 %

Confidence interval: 5 %

Population size: 6024

Finding out confidence level

Confidence level: 95 %

Confidence interval: 5 %

Sample size: 316

Population size: 6024

Sample size = 5%/95%×6024=316

Therefore, the questionnaire was administered to 316 households. The 316 households were considered as affair representation of the total households in the study area. Such a sample size is suitable for a survey research as advocated by Kathuri and Pals (1993), who recommended a minimum sample size of 100.

Confidence Interval: In statistics, a confidence interval is a particular kind of interval estimate of a population parameter. Instead of estimating the parameter by a single value, an interval likely to include the parameter is given. e.g. 40±1 or 40±5%.

Confidence Level: Also called confidence coefficient, Confidence level represents the possibility that the confidence interval is to contain the parameter e.g. 95% confidence level.

Population Size: In statistics, population is the entire entities concerning which statistical inferences are to be drawn. The population size is the total number of the entire entities.

Percentage: The percentage of a particular answer was chosen.

3.3.6 Non-probability sampling procedure

Non-probability sampling procedure allows the researcher to use only those elements in the population that are considered to have the required information with the respect to the objectives of the study. Purposive non-probability procedures were therefore used in this study to select four key informants with two of these from Kisii Metrological station which was used as a synoptic station around the study area and the other two from divisional Ministry of Agriculture (crop officers). By virtue of their work, these informants were considered to have important

insights on rainfall distribution data and maize production for the required study period 2010-2014.

3.3.7 Data Collection

Data used in this study were collected during the months of November and December; 2015. Several data collection instruments were used to obtain all the necessary primary and secondary data required for the study.

3.3.7.1 Primary data

Primary data was obtained through administration of a questionnaire and interviews with key informants. A questionnaire (Appendix A) was administered to selected households targeting the household head. The questionnaire was divided into three sections, each seeking specific type of data namely; household personal details, household income, other agricultural land use practices, farm characteristics and household food status.

A set of standard questions comprised the questionnaire. This had the advantage of eliciting standard answers to questions, making it possible for comparisons to be made between sets of data. The questionnaire was administered in English; however respondents who could not understand English were interviewed by translating the questions in the questionnaire in Kiswahili.

Also some questions were rephrased, clarified and others made more relevant to the context of the study problem. Besides the structured questionnaire, discussions and informal interviews were held with the four key informants who were chosen purposely to give insight information on maize production and other agricultural production

During data collection some problems were encountered, whereby some respondents were not comfortable with some questions and tended to hesitate in answering them. Such questions were those related to household incomes and expenditure. However, through constant probing and asking related questions like; how much do you spend in a day? Respondents were able to provide the needed information and data.

3.3.7.2 Secondary data

Secondary data was used to supplement the primary data. These data included Kuria East sub-County maize production data trends for five years (2010-2014) and rainfall validated data (Kisii Metrological Station) for five years from 2010 to 2014. Besides that, data was collected from library text books, journals, theses, periodicals and government publications.

3.3.7.3 Reliability and Validity

In order to determine the effectiveness of the research instrument, the questionnaire was pre-tested among 20 farming households (10 from each non sampled area in two neighbouring sub-Divisions; Maeta and Wangirabose). The sampled household heads responded to the questionnaire. Following the pilot test, modifications on various questions were made to clear or remove any ambiguities.

3.3.7.4 Field Observation

Besides use of the two instruments, the researcher made on-ground observations in the study area based on types of the crops grown in the field. This was important in gathering primary data that was used to compare the information reported in the questionnaire with the actual occurrences in the study area. The type of crops grown in various household farms were mainly maize (Plates 1and 2). However, some of the maize was infected by Maize Lethal Necrotic Disease (MLND). This maize disease has affected maize production in Kuria East sub-County leading to food shortage (MoA, 2015).

3.4 Data Analysis

Primary data gathered was coded and keyed into the computer using the SPSS software version 20 for subsequent analysis. Data was analyzed by use of both descriptive and inferential statistics using Microsoft Office Excel. Comparative line graph was used to analyze means of annual rainfall amount and maize production annually for a period of five years (2010-2014) for long and short rain seasons. The mean for JFMAM and OND rainfall amounts by pentad for the period 2010-2014. SPSS was used to analyze the household level factors and results presented in frequency distribution tables. Cross tabulation and chi- square was used to establish the relationship between the household decision maker, land size, age, education level, gender of the

household on the other hand, and maize production on the other. Frequencies and percentages were used to demonstrate effects of household level factors and other agricultural land use practices factors on maize production and the mitigation measures used to overcome food shortage in the study area.

3.5 Data Presentation

The data was analysed and presented in comparative line graphs to show variability of mean annual rainfall and annual maize production (measured in 90 Kgs/bag/acre). The rainfall and maize production comparative graphs were to establish relationship between rainfall amount and maize production for both long and short rain seasons while mean, frequencies, percentages, the cross tabulation and chi-square however, were used to show relationships between household level factors and maize production. Table 3.2 provides a summary of the study variables and analytical procedures.

Table 3.2: Data analysis matrix

Objective	Independent variable	Dependent variables	Statistical analysis
1. To determine the role of household and level factors influencing maize crop production in the study area.	**Household level factors** • Land tenure and ownership. • Land size • Gender relations • Age of the household head. • Education level of the household head. • Income of households • Political instability	Maize production • Increased • Decreased	Descriptive statistics: measures of central tendency to determine household level factors influencing maize production inferential statistics: cross tabulation and chi-square to show the relationship between land size, age, education, decision maker, gender, household head and maize production
2. To determine the environmental level factors influencing maize crop production	Validated Perception of farming households on environmental factors (rainfall variability and soil fertility	Maize production • Increased • Decreased	Descriptive statistics: comparative line graph to show the relationship between annual mean of rainfall amount and maize production for five years
3. To determine the role of other agricultural land use practices on household food crop production.	• Cash crops farming	Maize production • Increased food production • Decreased food production	Descriptive statistics: measures of central tendency to analyze the role of other agricultural land use practices.
4. To determine household food status and examine measures adopted, if any, to overcome food shortage in the study area.	• Land use practices • Availability of agricultural extension services. -Increased food production -Decreased food production	Food production • Credit accessibility • Cash crops farming	Descriptive statistics: to determine the household food status and mitigation measures adopted by households to overcome food insecurity.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents results and discussion of the findings of this study. The chapter is divided into the following sections: social economic characteristics of the respondents; farm yield (maize yield); the influence of household level factors on maize crop production; environmental level factors influencing maize crop production, role of other agricultural land use practices on household maize crop production and assessment of the current food status and mitigation measures used to overcome food insecurity in the study area.

4.2 Social economic characteristics of the Respondents

This section presents results of the first objective that sought to determine the role of household and level factors in influencing maize crop production. It presents study findings informed by a cross-sectional household survey conducted where by 316 respondents were interviewed.

4.2.1 Gender of the household head

Gender roles determine the amount of maize production and the kind of activity carried out by the household head, depending on whether the household head is a male or female. Males and females often have complementary roles, sharing or dividing tasks in crop production.

Table 4.1: Gender of the Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	160	50.6	50.6	50.6
	Female	156	49.4	49.4	100.0
	Total	316	100.0	100.0	

Source: Survey Data, 2015

It is evident from Table 4.1 that majority of the respondents (50.6%) were male while 49.4% were female. This implies that the gender distribution of farming households in Kuria East Sub County is fairly well balanced even if the male gender seems to be more than their female counterparts. This finding somewhat contradicts those of FAO (2013) which claim that female heads of households tend to play an important role as maize producers, managers of natural resources, income earners and caretakers of household food security; a study by Boserup (1970)

pointed out that, in Africa woman are involved in agriculture and play an important role in maize production than other regions of the world including Europe and Asia. In the Far East women are engaged in the production of maize crop and the tenure of animals and often control the marketing and trade of the produce (World Bank, 2009). According to the study carried out in Ghana by Doss (2011) the share of women in the labor force has a significant impact on the national food availability and positively influences domestic maize productivity. The agricultural productive potential of women, however, is not exploited to its full extent due to asymmetries in ownership of and access to agricultural inputs such as land, credit, pesticides and technology (World Bank, 2009; Deere and Doss, 2006).

4.2.2 Influence of Age of the household head on food crop production

Age of the household head is a critical factor in maize production. In this study, majority of respondents (54.8%) were aged between 31-40 years followed by 12.4% aged between 41-50 years; 21.2% between 18-30 years while 3.8% were above 51 years (Table 4.2). The results indicate that majority of the respondents are in their active age in terms of making vital decisions regarding maize crop production and adoption of various mitigation measures during food shortage. This study's findings are consistent with a research by Hofferth (2003) in Ethiopia, suggesting that the higher the age of the household head, the more stable the economy of the farm household, because older people have also relatively richer experiences of the social and environmental factors affecting maize production as well as greater experience of farming activities; a study in Ethiopia by Beyene and Muche (2010) points out that, as age of a household increases farmers acquire more knowledge and experience and become more food secure.

Table 4.2: Ages of the Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-30	92	21.2	29.1	29.1
	31-40	173	54.8	54.8	83.9
	41-50	39	12.4	12.4	96.3
	51+	12	3.8	3.8	100.0
	Total	316	100.0	100.0	

Source: Survey Data, 2015

4.2.3 Influence of Education level on food crops production

Level of education among members of the households and particularly that of heads of the households plays an important role in maize production (Kirimi et al., 2013). Formal education provides a route for the acquisition of useful knowledge on maize production due to ability to read and comprehend information of agricultural activities. Education also provides an avenue for employment opportunities as a source of income used to purchase food for the household.

Table 4.3: Level of education of the household head

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	primary	80	25.3	25.3	25.3
	secondary	160	50.6	50.6	75.9
	tertiary	76	24.1	24.1	100.0
	Total	316	100.0	100.0	

Source: Survey Data, 2015

From Table 4.3, it is observed that 50.6% of the sampled households had secondary schooling level, 25.3% had primary and 24.1% had tertiary schooling level. These results imply that most farmers had adequate education that could enable them to carry out agricultural activities with better knowledge on factors influencing maize production. This result is consistent with the finding from a research conducted by Haile, Alemu and Kudhlande (2005) in Ethiopia, who revealed that educational attainment by the household head could lead to awareness of the possible advantages of modernizing agriculture by means of technological inputs; enable them to read instructions on fertilizer packages and diversification of household incomes which, in turn, would enhance households' food supply. Further corroboration of the importance of education and its influence on maize production comes from the work of Sseguya (2009). In his study conducted in southeast Uganda on the relationship between social capital and food security the author argues that; factors such as age and education level of household head were associated with food security. Another study conducted by Mukudi (2003) in sub-Saharan Africa revealed that education plays an integral role in enabling individuals to access public information, especially concerning health, nutrition, and hygiene. He also argues that people with a minimum level of education are more likely than people with no education to obtain information about how to adopt a balanced diet, avoid illnesses, and maintain good hygiene, all of which improve food

security. On the other hand educated people can seek employment elsewhere and the income earned can be used for purchasing maize during food shortages.

4.2.4 Influence of Farming Experience of the household head on maize crop production.

The farming experience of the household head is significant in farming activities regarding maize production. It is important in creating awareness and perception of environmental and socio-economic factors influencing food production. Table 4.4, shows that 57.0% of the sample household heads have been involved in farming activities for over 10 years followed by 34.2% who had worked for between 5-10 years, and only 8.9% that had farming experience of 5 years and below. These findings indicate that most of the farming households had sufficient farming experience which is directly proportional to maize production. This finding is consistent with results from a study by Cahn (2007) who argued that farmers with experience are more aware of farming production issues and how it influences food security in their areas.

Table 4.4: Farming Experience of the Household Head

Farming Experience (in year)	Frequency	Percentages
Below 5	28	8.9
5-10	108	34.2
Over 10	180	57.0
Total	316	100.0

Source: Survey Data, 2015

4.3 Descriptive Analysis of the Research Findings

This section presents findings of each of the specific objectives, namely: the role of household level factors in influencing maize crop production in the study area, environmental level factors influencing maize crop production, the role of other agricultural land use practices on household food crop production and to assess household food status and measures used to overcome food insecurity in the study area.

4.3.1 The role of household level factors influencing maize crop production in the study area

Maize production refers to the quantities of maize a household produces from their own farm. Maize produced varies among households depending on; the total number of people in the household, land available for maize production, households' income, role of decision maker, incidence of pests and diseases also affect maize production (Plates 1 and 2). These factors among others interact to bring about variations in maize production across the sample population in different parts of the study location.

In this study, maize yield, was measured in 90 kilogrammes per bag. From Table 4.5 we observe that majority of the respondents (51.3%) obtained maize yield over 10 of 90kgs/bags per acre (average yield), followed by 24.8% with 1-5 of 90kg/bags (low yield) and lastly 23.9% with 6-10 of maize 90kgs/ bags (lowest yield). These figures show a decline in food production in the area. As argued earlier, over the recent years Kuria East sub-County has experienced insufficient maize production forcing the sub-County to rely on other regions of Kenya and the neighbouring country (Tanzania) for food provision (MoA, 2013). This has led to substantial amount of money being spent to purchase maize could have been invested in other sectors of the local economy (DAO, 2013). In 2012-2013, there was maize deficit in the study area of 9,221.625 Kenya shillings (Ibid). This situation raised concern at the sub-County level with regard to supplying adequate maize to meet the requirements of its habitants. Sustainable maize production is critical to uplifting living standards of the people as well as generating surplus for sale and hence sustaining of economic growth.

Source: Researcher, 2015

Plate 1: Maize Infected by Maize Lethal Necrotic Disease (MLND)-maize leaves dry from the tips, the maize plant is attacked at silk stage. In case the plant is attacked at an advance stage the entire maize plant withers (dries)

Source: Researcher, 2015

Plate 2: Maize planted without fertilizer (This has resulted to low yield of maize in the study area).

Table 4.5: Yields in 90kgs/ Bag of Maize/ Acre

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-5 bags	79	25.0	25.0	25.0
	6-10 bags	76	24.1	24.1	49.1
	over 10 bags	161	50.9	50.9	100.0
	Total	316	100.0	100.0	

Source: Survey Data, 2015

4.3.2 Role of Household level factors in influencing maize crop production

The first study objective sought to establish the role of household level factors influencing maize crop production. Based on household factors (size of the household, gender, level of education, decision-maker and monthly income level) the households gave different responses as presented below.

4.3.3 Size of the Household

Household size determines the amount of maize production by offering labour required by farming households. The bigger the household size (higher number of people), the higher the demand on food and its consumption.

Table 4.6: Size of the Farming Household

	Frequency	Percent	Valid Percent	Cumulative Percent
0-2	28	8.9	8.9	8.9
2-4	90	34.2	34.2	34.2
above 5	108	57.0	57.0	100.0
Total	316	100.0	100.0	

Source: Survey Data, 2015

From the survey data (Table 4.6), it is evident that majority of sample respondents (57.0%) had their household size at more than 5 persons, followed by 34.2% at between 2 and 4, and, 8.9% at between 1 and 2. This suggests that the size of the households was relatively large (majority households had above 5 persons). High number of household dependents' is likely to increase maize demand and consumption in a household. In cases of food shortages, the household is likely to ratio the little food for consumption. This outcome is consistent with the research finding by Stephens (2000) in Ethiopia who noted that food usage increases with the increases of mouths to feed. This subsequently suggests that households need to produce more food depending on the amount of consumption.

Table 4.7a: Cross tabulation of Household size and Maize Production

			maize yield in 90 Kgs/bags/acre			
			1-5 bags	6-10 bags	over 10 bags	Total
household size	0-2	Count	7	8	15	30
		% within maize yield in 90 Kgs bags	8.9%	7.9%	9.3%	9.4%
	2-4	Count	34	29	70	133
		% within maize yield in 90 Kgs bags	43.0%	38.2%	43.5%	41.8%
	above 5	Count	38	41	76	155
		% within maize yield in 90 Kgs bags	48.1%	53.9%	47.2%	48.7%
Total		Count	79	76	161	316
		% within maize yield in 90 Kgs bags	100.0 %	100.0%	100.0%	100.0 %

Source: Survey Data, 2015

Table 4.7, shows that households with over 5 members produced over 10 (90kgs/bag)/acre of maize (47.2%) than household sizes with below 5 members who produced less than 10 (90kgs/bags) of maize. However, a greater proportion of farmers produced more than 10 bags with larger number of household sizes (48.7%). This could be attributed to the fact that a large household size acts as source of labour which is an important factor in maize production. Increased maize production by large sized households is fueled by the farmers' needs to produce more food to meet the household's food requirements. The findings of the current study are comparable to a study by Babatunde *et al.* (2007) in Nigeria who reported that in farming activities, households with larger labour supplies are better positioned to increase the productivity of their land.

Table 4.7b of Household size and Maize Production

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.290[a]	4	.863
Likelihood Ratio	1.290	4	.863
Linear-by-Linear Association	.267	1	.605
N of Valid Cases	316		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.17.

From the chi square analysis, it can be observed that the value of Pearson chi square is 1.29 with 4 degree of freedom and p- value of 0.863. This means that there is no significant information to conclude that the amount of maize produced by the household depend on the size of the household. From the field study, it was noted that most of the households used hired labour in their farm on maize production.

4.3.4 Household Decision Making and Its influence on Maize production

Decision making at household level is important, especially with regard to issues concerning food production. Respondents in this study gave their views regarding the primary decision maker on matters concerning maize production where 84% of the decision makers were male heads of households followed by 16% who were females. This implies that male household heads made a significant number of decisions in as far as farming is concerned. This could be a negative sign since women are important as food producers, managers of natural resources, income earners and caretakers of household food security.

Table 4.8a: Cross tabulation of Decision Maker at Household level and Maize Production

Maize yield in 90 Kgs bags * who is the decision maker in your household? Cross tabulation

			Who is the decision maker in your household?		
			Male	Female	Total
maize yield in 90 Kgs bags	1-5 bags	Count	59	20	79
		% within maize yield in 90 Kgs bags	74.7%	25.3%	100.0%
	6-10 bags	Count	69	7	76
		% within maize yield in 90 Kgs bags	90.8%	9.2%	100.0%
	over 10 bags	Count	127	36	163
		% within maize yield in 90 Kgs bags	77.9%	22.1%	100.0%
Total		Count	253	63	316
		% within maize yield in 90 Kgs bags	80.2%	19.8%	100.0%

Source: Survey Data, 2015

From Table 4.8a it is observed that in the study area, a higher percentage of male household heads (80.2%) were decision-makers concerning the issues of maize production and supply compared to the female household heads (22.1%). The head of household is considered as a source of authority which is determined by culture; land owner ship, economic contribution among other factors. The female produced 10 bags of 90kg maize (average yield /acre), but overall, a greater proportion of male household heads produced more than 10 bags (77.9%). Gender is a central factor in decision making which affects maize production, time allocation and investment in developing countries (Fawehinmi and Adeniyi, 2014).

Table 4.8b. Decision Maker at Household level and Maize Production

	Value	Df	p-value
Pearson Chi-Square	7.414[a]	2	.025
Likelihood Ratio	8.344	2	.015
Linear-by-Linear Association	.012	1	.914
N of Valid Cases	316		

Source: Survey Data, 2015

From the chi square analysis, it was observed that the Pearson chi square value is 7.414 with 2 degrees of freedom and p- value of 0.025 which is less than 0.05 level of confidence. This suggests that there is sufficient evidence to conclude that maize production is significantly influenced by the decision-maker either the male or the female.

4.3.5 Monthly Income Levels

Income earned from selling of assets, cash crops, livestock and either on-farm or off-farm activities help households in supplementing maize production. Such income acts not only as a form of buffer in the event of crop failure, but also allows the farming households to take risks involved in trying new farming technology and innovations. Table 4.9 shows monthly income earned by sampled farming households in the study area.

Table 4.9: Monthly Income Levels (Kshs) of Household Head

Monthly Income Levels (Kshs)	**Frequency**	**Percentages**
Less than 500	12	3.8%
501-1000	85	26.9%
1001-3000	173	55.8%
3000 and above	46	14.5%
Total	316	100.0%

Source: Survey Data, 2015

From Table 4.9, we observed that a significant proportion of the respondents (55.8%) earned between Kshs 1001 and 3000 a month, followed by 26.9% who earned between 501 and 1,000 a month, 14.5% above 3000 shillings and only 3.8% less than 500 shillings. Based on this finding, it is observed that majority of sample respondents (54.8%) in the study area earn between Kshs 12,012 and 36,000 in one year. According to GoK (2000a, 2000d) estimates a national absolute poverty line of Kshs 1,239 per month per adult in rural areas and Kshs 2,645 in urban areas for food and non-food expenditure. Twenty six point nine percent (26.9%) of the sample household spend between Kshs 501 and 1000 per month per person. Such households are considered poor and live below poverty line, Studies of people who suffer food insecurity across different countries and health systems have consistently found that it is closely related to limited household resources, low disposable income and poor socioeconomic status (Cook and Frank, 2008; Else, 1999). This basically means that based on the high cost of living, respondents who earn between Kshs 501-1000 are unable to get all kinds of food they need with the monthly income bearing in mind all other costs to be incurred from the said income.

4.3.6 Farmers' Perceptions on environmental level factors influencing maize production

Perception is the way small-scale farmers think and behave in form of aggregate knowledge in addition to attitudes or beliefs held by farming households which influence maize production. The perceptions farmers have about environmental factors (rainfall variability and soil fertility) are closely related to the knowledge they have about it (Guerena *et al.,* 2016). Whereas knowledge refers to factual information and understanding of how the farming households' perceptions relate to the views farmers hold about environmental factors based on their felt needs and prior experiences (Jerneck and Olsson, 2014).The influence of farmers' perception and the factors affecting maize production remain crucial and cannot be overlooked if maize yield is to be improved in developing countries where agriculture still relies heavily and almost exclusively on rainfall (Mamba, Salam and Peter, 2015).

4.3.6.1 Role of Environmental level factors in influencing maize crop production

In addition to household level factors; the role of environmental level factors influencing maize crop production was examined as the second objective of this study. Based on farmers' validation perception on environmental factors (rainfall variability) the households gave different responses as presented in Tables 4.10.

4.2.2.1 Rainfall Variability

This section examined rainfall variability and its effect on maize production.

Table 4.10: Small-Scale Farmers' Perception on Rainfall Variability of Kuria east sub-County

	SA		A		N		D		SD		Mean	StD
	F	%	F	%	F	%	F	%	F	%		
Reliable rainfall	64	20.3	180	57.0	18	5.7	44	13.9	10	3.2	3.18	.81
Satisfactory short rains	44	13.9	180	57.0	22	7.0	54	17.1	16	5.1	3.28	.82
Satisfactory long rains	70	22.2	162	51.3	24	7.6	48	15.2	12	3.8	2.67	.87
Drought interference	56	17.7	182	57.6	20	6.3	46	14.6	12	3.8	2.47	1.1

Source: Survey Data, 2015

Key: SA-Strongly Agree (5), A-Agree (4), N-No comment (3), D-Disagree (2), SD-Strongly Disagree (1), StD-Standard Deviation, F-Frequency and %-Percentage.

As depicted in Table 4.10 rainfall is the main factor that influences plant growth and crop productivity. In response to farmers' perception on rainfall 77.3% perceived reliable and predictable rainfall. 26.1% perceived unreliable rainfall and 5.7% were neutral. The variability of rainfall at the start of the seasons as well as during mid-season often resulted to low maize crop yield. A rainy season wets the soil sufficiently for planting; these events may be followed by long dry spells (Barrios *et al.,* 2008). This result indicates that the rains came at the right time in amounts that were expected leading better yields.

The respondents were also asked whether the rains were adequate in amount during the short rain season from (OND) every year. To this question these were the responses: 70.9% agreed, 22.2% disagreed and 7.0% were undecided. This implies that according to the sample respondents rains were in adequate amounts. Despite of this, the yields were still low. What could this therefore mean in terms of factors affecting maize production? Even in those regions where rainfall is

high, individual events are often characterized by severe storms, resulting in considerable loss of rainfall in run-off.

As to whether agricultural production was hindered or not by drought in the area, 75.3% of the respondents agreed, 18.4% disagreed and 6.3% were neutral. This could imply that occasionally, drought was experienced in the area when planting had been done or was about to be done and thus affected crop production. This result is consistent with the research findings from a study in Kwale County by Ochieng' (2013) on rainfall variability and adaptation mechanism on smallholder famers in Kwale County, Kenya. In the study in reference it was found that agricultural production in Kwale County depends on rainfall received during OND and MAM season. Rainfall is increasingly becoming a source of concern, particularly in the rain fed agricultural regions such as Kuria east sub-County (DAO, 2013). A research carried out by Mamba (2015) in Swaziland, points out that in many developing countries, the agricultural sector is highly dependent on rain-fed production and therefore vulnerable to weather shocks. Unprecedented rains pose challenges to developing world due to the latter's dependence on climate-sensitive economic activities and predominantly in practicing rain-sustained agricultural activities (Shisanya and Khayesi, 2007). This is largely due to its variability, distribution and seasonality. Kuria East sub-County is a typical rain fed agricultural region, where scarcity of rainfall in both amount received and in distribution (Kisii Metrological Station, 2015), have continued to pose major threats to the growth of maize crop and have contributed significantly to the poor yield and high variability in maize production from year to year. Figure 3.3 and 3.4 displays the annual mean rainfall for five years from Kisii metrological station and maize production (validated data) from crop officers in the study area respectively.

Figure 3.3 presents a comparative line graph showing annual mean rainfall amount and maize production for long rain season (JFMAM).The graph shows the relationship between the annual mean rainfall received and the maize yield for five years during long rain seasons. The line graph depict a decrease of rainfall from 2010-2011 followed by an increase from 2011-2013, and then an increasing trend from 2011-2013. This was followed by a decrease of rain from 2013-2014. Maize production increased from 2010 -2013 followed by a decreasing trend. The high maize yields were attributed to most farming households growing maize in the long rain season. Beside that the farming households also observed good agronomical practices.

Figure 3.4 presents a comparative line graph showing annual mean rainfall amount and maize production for short rains (OND).The graph shows the relationship between the annual mean rainfall received and the maize yield for five years during short rain seasons. The line graph depict a decrease of rainfall from 2010-2011 then increased from 2011-2012 followed by a drop of rainfall in the period 2012-2014. The lower figure of maize yield recorded during the 2010-2013 was attributed by failure of most farmers to plant maize during short rain season. As a result most of farming land was left fallow awaiting the next planting season that is, long rain season (Personal Communication with Stephen Maswage, Kegonga, December, 2015). Farming households in Kuria East sub-County rely more on maize production to meet household food demand. The amount of rainfall received determines efficiency of maize crop growth and yields. Kuria East sub-County has two planting seasons. Among the two seasons the dominant season is long rain season (JFMAM) which is the longest rain season. This season do accommodate all varieties of maize including late and early maturing.

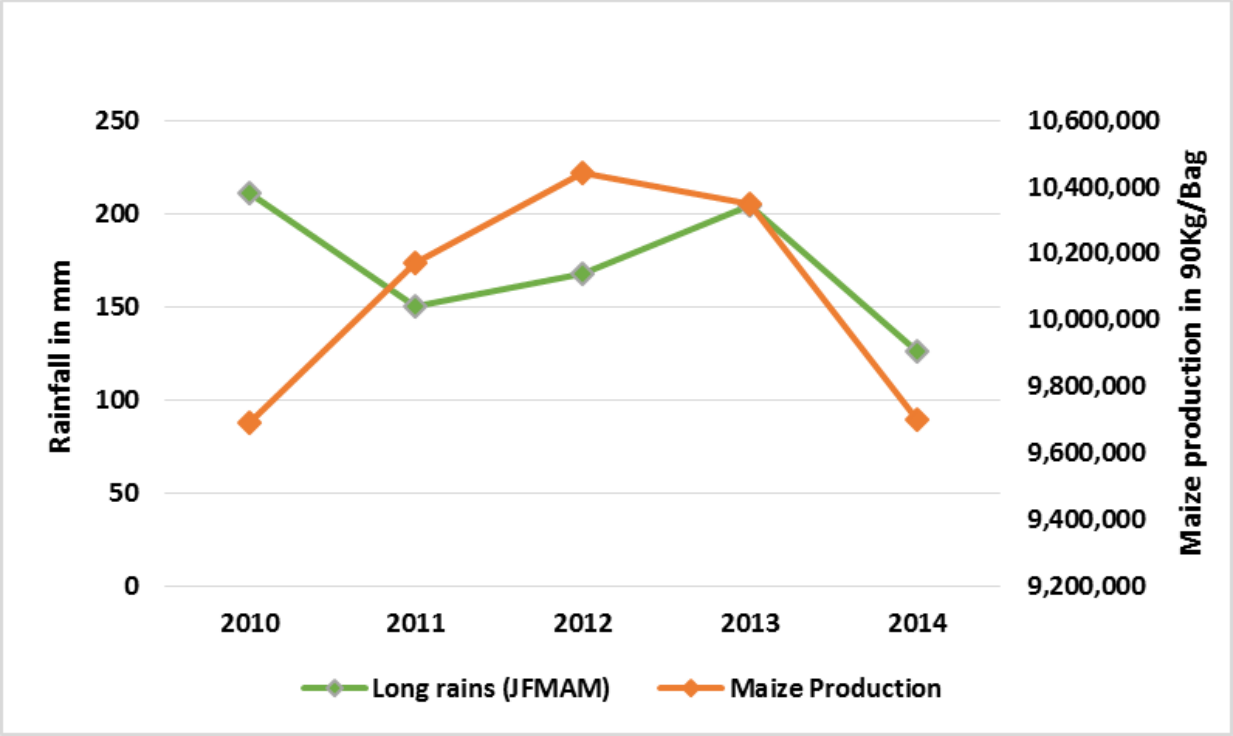


Figure 3.3: Comparative Line Graph Showing Long rain Mean Annual Rainfall Amount and Maize Yield in 90kg/ bag/ acre between 2010-2014

Source: Kisii Metrological Station and DAOs Validated Data Kuria East Maize Production

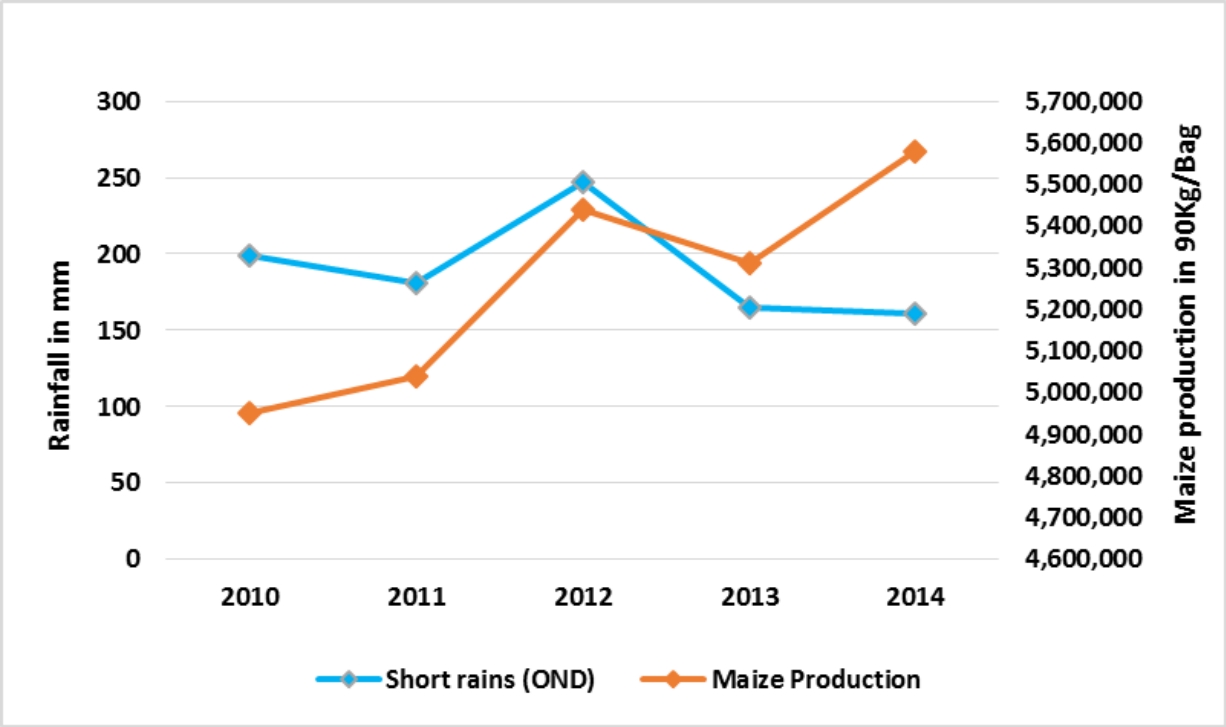


Figure 3.4: Comparative Line Graph Showing Short rain Mean Annual Rainfall Amount and Maize Yield in 90kg/ bag/ acre between 2010-2014

Source: Kisii Metrological Station and DAOs Validated Data Kuria East Maize Production

4.2.2.2 Farmers' Perception of how Soil fertility influences maize production

Soil fertility is the ability of soil to function within natural or managed ecosystem boundaries to sustain plant productivity. In effect, fertile and healthy soils are crucial in efforts to reduce food insecurity (GoK, 2016). Thus, the sample respondents reported various perceptions on soil fertility situation in the study area as shown in Table 4.11; accordingly 61.4% perceived that their soil was not sufficiently fertile to promote agricultural food production. Only 31.6% of the sample respondents perceived that their soil was fertile, and 7.0% were neutral. This suggests that soil fertility in the study area presents some challenges in food production.

Table 4.11: Small-Scale farmers' Perception on Soil fertility in Kuria East sub-County.

	SA		A		N		D		SD		Mean	StD
	F	%	`F	%	F	%	F	%	F	%		
Fertile soil	38	12.0	62	19.6	22	7.0	146	46.2	48	15.2	2.70	1.0
Moderately fertile soil	32	10.1	64	20.3	26	8.2	156	49.4	38	12.0	3.05	.87
infertile soil	40	12.7	148	46.8	24	7.6	64	20.1	40	12.7	2.67	.83
Apply fertilizers	38	12.0	160	50.6	24	7.6	58	18.4	36	11.4	2.87	.94

Source: Survey Data, 2015

Key: SA-Strongly Agree (5), A-Agree (4), N-No comment (3), D-Disagree (2), SD-Strongly Disagree (1), StD-Standard Deviation, F-Frequency and %-Percentage.

A study by Sah (2002) in Nepal indicated that farmers' perception of soil quality was measured by the type of weeds growing in a given farm land. Another study which corroborate with the finding of this study is by Stephen (2000) in Ethiopia who found that a decline in soil fertility negatively affects maize production.

Finally, when the sample respondents were asked if they used inorganic or organic fertilizers to improve soil fertility, 62.6% stated that they did, 29.8% did not use and 7.6% were undecided. These results indicate that in view of the poor status of their soils, the farmers used fertilizers to help improve the fertility. This finding is consistent with the research finding of studies by Hossner and Juo, (1999) found that poor maintenance of soils remains a major environmental issue in countries of sub-Saharan Africa and this has affected food productivity. Studies by Barrios *et al*., (2008); DAO, (2011); Stephen, (2000) pointed out that fertilization of farmland can boost agricultural production and influence the food security status of a household. Another study that was carried out by Vanlauwe *et al.*, (2015) in Nyando and Yala basins in rural Kenya established that the importance of soil fertility in the context of agricultural development, major barriers remain in our understanding of how farmers form perceptions about their soil fertility,

and how soil fertility (perceived, directly measured, and estimated) is related to farmers' behaviors in terms of input use, cropping strategies, and other management practices.

4.2.2.4 Land size under Maize production

Maize production is influenced to a large extent by households' land size. Households with large farm size can produce more maize because they are able to grow a variety of maize crop and hence improve food security. Table 4.12 shows the distribution of land area under maize production

Table 4.12: Land area under Maize production in Kuria East sub-County

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0.1-1.0	64	20.1	20.1	20.1
	1.1-2.0	110	35.2	35.2	55.3
	2.1-3.0	105	33.0	33.0	88.4
	above 3.1	37	11.6	11.6	100.0
	Total	316	100.0	100.0	

Source: Survey Data 2015

This study indicates that 35.2% of the respondents owned between 1.1-2.0 acres of land under maize production; this was followed by 20.1% with (0.1-1.0 acres), 33% at 2.1-3.0 and 11.6% (above 3.1 acres) under maize production. This suggests that a relatively small land size was used for maize production. The varied sizes of land owned by small scale farming households in the study area contradicts to the average land size owned by subsistence farmers in Migori County. Averagely subsistence farmers own 3 acres and for large farms 7 acres. Small farms are used for substance farming while large farms are used for livestock and tobacco growing (GoK, 2013).

Table 4.13: Cross tabulation of land area under Maize Production and quantity Produced.

		Approximate land area under food production in acres				Total
		0.1-1.0	1.1-2.0	2.1-3.0	above 3.1	
maize yield in 90 Kgs bags	1-5 bags	26	26	22	5	79
		32.9%	32.9%	27.8%	6.3%	100.0%
	6-10 bags	13	31	20	12	76
		17.1%	40.8%	26.3%	15.8%	100.0%
	over 10 bags	25	55	63	20	163
		15.3%	33.7%	38.7%	12.3%	100.0%
Total		64	112	105	37	316
		20.1%	35.2%	33.0%	11.6%	100.0%

Source: Survey Data, 2015

Cross tabulation (Table 4.13) shows that the largest land area under maize production ranged between 2-3 acres (38.7%) produced over 10 bags of maize (90Kgs/bag) than acreage between 1.1 and 2.0 (33.7%). Also, an acreage of 0.1-1.0 gave a yield of between 1-5 bags (90 kg/bag) higher than what was produced under an acreage of 1.1-2.0. However, overall, a greater proportion of farming households produced over 10 bags (90Kgs/bag) per acre with a large land area (51.3%) of land area under food production. These findings compare favorably with several studies; Kumba, Wegulo and Otieno, (2015_a) and Van Der Veen and Tagel, (2011). In their study in Kisii County, reported that a large percentage of households who owned less than one acre (97.6%) were involved mainly in maize production while those with higher acreage were engaged in both maize and cash crop production which increased their chances of being food secure. Similarly, FAO (2006) who conducted a study in northern Ethiopia, points out that with increased land under cultivation, the farmer can produce more maize for sufficient consumption and also diversify.

4.2.3 Agricultural land use practices and household maize crop production

This section addresses the third objective of the study that sought to examine the role of other land use practices their influence on maize production. Although maize crop production and cash crop production are often seen as mutually exclusive, increased cash crop production need not reduce maize availability at household level (FAO, 2014; IFAD, 2013 and WFP, 2013). Tobacco being a major cash crop in the study area bring substantial wage and employment opportunities

to rural economy (IFAD, 2013). Increased production of maize for market is both an inevitable feature of rural development, and essential if agricultural sector is to support economic development (Von Braun and Kennedy, 1994). Production of cash crops may enable farming households to obtain more maize and income than they could obtain by devoting the same household resources to maize production alone. Additionally the cash crops produced have a higher value than consumed maize within the household (Maxwell and Fernando, 1989).

According to findings from this study, a part from land being utilized for growing maize crop, other uses to which land is put include; raising of livestock, tobacco and coffee growing, and fish farming (Table 4.14).

Table 4.14: Percentage Distribution of Respondents engaged in other Farming Practices in Kuria East sub- County

	Frequency	Percent	Valid Percent	Cumulative Percent
Livestock keeping	79	25.0	25.0	25.0
Tobacco growing	101	31.9	31.9	56.9
Coffee farming	80	25.3	25.3	82.2
Fish farming	56	17.7	17.7	100.0
Total	316	100.0	100.0	

Source: Survey Data, 2015

Table 4.14, further shows that in addition to growing maize crop, farming households used their land for other agricultural land use practices; 31.9% were engaged in tobacco growing, 25.3% used their land for coffee farming, and 25.0% were involved in livestock keeping and 17.7% fish farming. A number of the farming households also stated that they had been involved in other agricultural practices such sugar cane growing. A number of observations can therefore be made based on the data. First, it is clear that a significant number of farmers do not rely on one land use enterprise. Instead, their farming practices are diversified. Second, the data shows the extent to which engagement in other land use practices is likely to reduce land available to small scale farmers' for maize crop production. Thirdly, tobacco is a cash crop in the study area and expected to give high returns to the farming households.

Results from this study therefore provide indications that the sample farmers in the study area engaged in other agricultural practices to diversify and complement their assets (food and cash entitlements). As noted, these enterprises may have posed a challenge and competition to maize crop production, but on the whole, the incomes arising from the cash crop farming has helped to ensure food security in the study area.

Findings from this study corroborate research findings by among others; Von Braun and Kennedy (1994) who found that household participation in cash crop production need not reduce own food production or nutritional status, although it is equally naïve to expect that income from cash crops will automatically translate into improved nutritional status; A study by Stephen (2000) in Ethiopia advocated for an expansion of agricultural activities to improve food security. Cash crop production enables farmers and farm workers to increase their living standards, thus contributing to food security. Moreover, the production of cash crops offers farmers opportunities for investment and improving management of their farms, stimulating agricultural innovation and increasing yields (Fan, Joanna, Michael and Halsema, 2013). On the other hand, farm revenues from cash crops are often invested in food production, for example in the increased use of farm inputs, raising maize production (Von Braun and Kennedy, 1986).

4.2.4 Household food status in Kuria East sub-County

This section addresses the third objective of the study that sought to assess the household food status in Kuria East sub-County. The study assessed household food status with respondents being asked whether the maize produced in each season was able to take them up to the next season. Respondents gave varied answers, with; 69.0 % indicating that they had adequate food while 31.0% did not have adequate food (Table 4.15). These research findings compare well with other studies conducted by Koloi *et al.,* (2005) in Mwingi district who found that, 62% of households in Mwingi District were food secure while 38% households were food insecure; Kumba (2015) conducted a study in Kisii Central sub-County in which she found that majority of the households (77.5%) were food secure while 22.5 % were food insecure. In view of her findings, (Ibid) recommends increased use of extension service especially in empowering farming households to use modern technologies and agronomic practices in order to improve food crops production at household level.

Table 4.15: Household food status in Kuria East sub-County

Household food status	Frequency	Percentages
Households with adequate food	218	69.0%
Households without adequate food	98	31.0%
Total	316	100.0%

Source: Survey Data, 2015

4.2.5 Mitigation measures used to overcome food insecurity in the study area

As it has been indicated in Table 4.15, 31.0 % of the sample households reported having inadequate food. It was therefore considered necessary to find out how farming households in this group were able to address the shortfall in their food needs. Results show that farming in this group relied on various mitigation measures to take care of the food needs. We observe that 83.6% offered labour service for food, followed by 82.4% who sold cash crops or livestock to buy food, 67.6% bought food from other farmers; 67.6% sold assets to buy food, and 43.4% borrowed food from their neighbors.

Table 4.16: Mitigation Measures used to Overcome food insecurity in the Study Area

Statements	Yes		No	
	Frequency	%	Frequency	%
Buying food from other farmers	215	67.6	103	32.4
borrowing food from neighbours	139	43.4	179	56.3
Offering labour service for food	266	83.6	52	16.4
Selling cash crops/livestock to buy food	262	82.4	56	17.6
selling assets to buy food	215	67.6	103	32.4

Source: Survey Data, 2015

These findings corroborate those of Kang'ara, Ngoroi, Muturi, Amboga, Ngugi and Mwangi (2001) in Embu who noted that livestock contribute to households' economy in different ways, e.g. as a source of cash income and source of supplementary food. Besides, livestock are considered a means of security and means of coping during crop failure and other calamities.

FAO (1999) reports that employment in off-farm and non-farm activities are essential for diversification of the sources of farm households' livelihoods. Involvement in these activities enable households to modernize their production by giving them an opportunity to apply the necessary inputs, and reduces the risk of food shortage during periods of unexpected crop failure through food purchases. Studies by Devereux (1993); Maxwell & Frankenburger (1992) argue that in Africa, diversification of sources of income has long been a survival strategy which allows household heads to reduce the risk of starvation for themselves and their families during periods of chronic or transitory food insecurity. In this study, households diversify their incomes by selling their assets and working on-farms as daily labourers in order to buy food (Personal Communication with Ivan Matinde, Ntimaru, December, 2015).

CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of research findings, the conclusions drawn and the recommendations made thereof.

5.2 Summary of the Study findings

This study sought to achieve the following objectives; to determine the role of household and level factors influencing maize production in the study area; to determine the environmental level factors influencing maize crop production in the study area; to examine the role of other agricultural land use practices on household maize production, and assess household food status among sample respondents in Kuria East sub-County.

Both primary and secondary data were used to elucidate maize production situation in the study area. Based on the first objective; the study established that household level (socio-economic) factors such as, land size, gender relations, decision maker and household income had an influence on food crops production. The sample respondents gave different responses 57% had a household size of more than five members; 54.8% had land size of 1.1-2.0 acres; 84% household decision makers were male; 16% were female; 54.8% earned between 1001 and 3000 shillings a month to meet both food and non-food demands. Using the national poverty line estimates, such households can be regarded as poor and live below the poverty line.

Further, the second objective established that farming households had varied validated perceptions on environmental factors (rainfall variability and soil fertility) as determinants of maize production; With regard to rainfall; majority of the farming households perceived rainfall in the study area to be reliable throughout the year. Based on soil fertility, 31.6% of the sample respondents' perceived soil to be fertile for their agricultural needs, 30.4% perceived the soils as moderately fertile, 59.5% perceived the soils as being infertile.

Based on the third study objective; majority of respondents (83.9%) confirmed that apart from maize crop farming they used their farms for other agricultural practices (growing of tobacco, coffee livestock rearing and fish farming). Engagement in these activities although offering

competition to maize production, helped to earn income that may have been used to buy food especially during the periods when food shortage is rampant.

The Fourth objective was based on the current food status of the sample households. Results showed that, majority (69%) of the respondents had adequate food while 31% did not have adequate food. The use of various mitigation measures by households without adequate food helped to improve accessibility to food especially during periods of food shortage. Mitigation measures included the following: offering labour for food, selling cash crops and livestock to buy food, purchase of food from other farmers, borrowing from neighbours and relatives and occasionally selling household assets to buy food.

5.3 Conclusions

This study examined factors influencing maize crop production in Kuria East sub-County. The role of household level factors (household size, gender relations, decision-maker, land tenure, household head, education level, and household head) influencing maize crop production in the study area; environmental level factors (rainfall variability and soil fertility) influencing maize crop production; the role of other agricultural land use practices on household maize production and the current food status in the study area. These factors are considered useful in providing clear information on the factors influencing maize production and the course of action households take when faced with maize shortage. The concerned agencies could use such information to come up with long- lasting interventions to food security in the study area.

From the summary findings, the study draws the following conclusions: In respect to the first objective of this study, it is evident that household size, gender of farm-decision maker, household income and factors such as land tenure and farm size have affected maize production at household level in the study area.

As regards objective two, it is concluded that farming households had varied responses regarding farmers, perception of environmental level factors (rainfall reliability and soil fertility) on maize production.

Considering objective three, the role of other agricultural land use practices on maize crop production; tobacco growing is the major cash crop grown in the study area and hence give high return to the farming households which ensure food security in the study area.

In view of objective four, results show that majority of the households in the study area have adequate food. Nevertheless, food secure households in this study area have attained this status through reliance upon various mitigation measures to minimize the risks associated with lack of access to food.

5.4 Recommendations of the Study

In the view of the above conclusions, this study makes the following recommendations relating to policies, programmes and future research regarding food availability in the study area.

5.4.1 Policy recommendations

First, there is need to improve accessibility to food among the households that do not have adequate food. This can be achieved by using income earned from the sale of cash crops to purchase food during shortages. Farming households should improve soil fertility by use of organic and inorganic fertilizer to increase maize crop production. Women's empowerment should also be embraced by increasing their role in decision making at all levels, including the households and local communities. This is vital for the community to benefit from the increased contribution that women make to food and nutrition security.

5.4.3 Other agricultural land use practices

Farming households that engage in the production of cash crops should be encouraged by stakeholders (crop officers and NGOs) to ensure that the income earned from growing cash crops is used to beef up food stocks for their households.

5.5 Recommendations for Further Research

The researcher recommends further research in the following areas; examining the role of non-farm sources of incomes, and the extent to which such incomes can help to cushion and increase food assets at household levels. Further research may also be conducted on devolution and the transfer of functions of the Ministry of Agriculture, Livestock and Fisheries, and the influence this may have on maize production in the study area.

REFERENCES

Ackello-Ogutu, C. and Echessah, P. (1997) "*Unrecorded Cross-Border Trade between Kenya and Uganda: Implications for Food Security." SD Publication Series, Office of Sustainable Development Bureau for Africa,* USAID, Technical Paper No. 59, July 17(1): pp 9-18.

Adger, W. N., Hug, S., Brown, K., Conway, D., & Hume, M. (2003). *Adaptation to Climate Change in Developing World.* Progress in Development Studies, *3*(3), 179-195. Available at http://dx.doi.org/10.1191/1464993403ps060oa

Agarwal, B. (1997). "Bargaining and Gender Relations: Within and Beyond the Household". *Feminist Economics* 3 (1), pp. 1-51.

Alliance for a Green Revolution in Africa (2013). *Africa Agriculture Status Report: Focus on Staple Crops.* Nairobi: Smart Printers.

Amanor, K. (2003). *Land and Sustainable Development in West Africa*, Africa Institute for Agrarian Studies Working Paper, Harare: AIAS. *Among Smallholder Farmers in Kenya.* Availableat:www.ageconsearch.umn.edu/...0Millicent%20Olunga.pdf

Anderson, J. R. (2007). *Agricultural advisory services*. Background paper for *World Development Report 2008*, Agriculture for Development. Washington, DC: The World Bank.

Ati, O.F., Stigter, C. J. and Oladipo, E.O. (2002). A Comparison of Methods to Determine the Onset of the Growing Season in Northern Nigeria. *International Journal of Climatology,* 22: 731–742.

Babatunde, R.O., Omotesho, O.A. and Sholota, O.S. (2007). *Socio-economic characteristics and food security status of farming households in Kwara state*, North-Central Nigeria.

Baden, S. (2013).*Women's Collective Action: Unlocking the Potential of Agricultural Markets*, Oxfam Research Reports, and Oxford: Oxfam International, Available at http://oxfamilibrary. openrepository.com/oxfam/bitstream/10546/276159/6/rr-womens-collective-action-unlocking-potential-africa-agriculture-270312-en.pdf

Bancy, M.M. (2000). The influence of climate change on maize production in semi humid and semi-arid areas if Kenya. *Journal of Arid Environment.* 46: 333-334.

Barrett, B.C. (2006). *Food Aid's Intended and Unintended Consequences Background*; Paper for Food and Agriculture Organization; Food and Agriculture Organization: Rome, Italy, 2006.

Barrios, S., Ouattara, B., & Strobl, E. (2008). *"The impact of climatic change on agricultural production:* Is it different for Africa?" *Food Policy* 33 (2008) 287–298.

Berazneva, Julia, David R. Lee, Frank Place, and George Jakubson (2016). Allocation and valuation of non-marketed crop residues in smallholder agriculture: The case of maize residues in western Kenya." Working Paper, Cornell University, Ithaca, NY.

Beyene, F. and Muche, M., (2010). *Determinants of Food Security among Rural Households of Central Ethiopia:* An Empirical Analysis Quarterly Journal of International Agriculture 49 (2010), No. 4:299-318

Beyer, J. and Brigden, W, L. (2003).*Tobacco Control Policy- Strategies, Successes Setbacks***.**The World Bank-Washington DC, USA.

Bogale, A. and Shimelis, A. (2009). *Household level determinants of food insecurity in rural areas of Dire Dawa, Eastern Ethiopia.African Journal of Food and Agriculture, Nutrition and Development.* Volume 9, No 9.

Bongaart, J. and Bruce, J. (1998). *Population Growth and Policy Options in the Developing World,* 4pp.Washington, DC: International Food Policy Research Institute, 2020 Vision Brief 53.

Borlaug, N. E. (2009). "Sixty-two years of fighting hunger: personal recollections". *Euphytica. 157* (3): 287–297. Doi: 10.1007/s10681-007-9480-9. Retrieved 2015-09-05

Boserup, E. (1970) *Women's Role in Economic Development.* New York.

Breman, H. (2003). *West Africa's substance farming.* Food and Agriculture Organization. Rome Togo 16.

Cahn, M. (2007). *Sustainable Livelihood Approach: Concepts and Practice*, Massey University.

Carloni, A. and Crowley, E. (2005). *Rapid guide for missions.* Analyzing local institutions and livelihoods. FAO Rome 34 ppftp://ftp.fao.org/docrep/fao/008/a0273e/a0273e00.pdf

Carter, M.R. (1989). "The Impact of Credit on Peasant Productivity and Differentiation in Nicaragua." *Journal of Development,* 31:13-36

Castaneda, T. (1999). *The design, implementation and impact of food stamp programs in developing countries,* 47 pp. Washington, DC: World Bank Discussion Paper.

Chacha, B. K. (1999). *"From Pastoralists to Tobacco Peasants: The British American Tobacco (B.A.T) and Socio-ecological Change in Kuria District Kenya, 1969-1999."* Unpublished MA Thesis. Egerton University.

Chambers, R. (1983). *Rural development: Putting the Last First*. London: Longman.

Cook, J. T. and Frank D. A. (2008). *"Food Security, Poverty, and Human Development in the United States." Annals of the New York Academy of Science* 1136:193–209.

Cotlear, D. (1990). The effects of education on farm productivity, in Keith Griffin and John Knight, eds., *Human Development and the International Development Strategy for the 1990s.* London: MacMillan.

Cronbach, L.J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika.*16,297-334.

DAO, (2012). *Kuria East District Agriculture Office*. Report of August 2012.

DAO, (2013). *Kuria East District Monthly Food Security Report of July 2013*.

Deere, C.D. and Doss, C.R. (2006). *Gender and the Distribution of Wealth in Developing Countries. Working Paper RP2006/115*. World Institute for Development Economic Research (UNU-WIDER).

Dercon, S. (2004): *Growth and shocks: Evidence from rural Ethiopia*. In: Journal of 65 Development Economics 74 (2): 309-329.–(2005): Insurance against poverty. Oxford University Press, Oxford.

Devereux, S. (1993). *Goats before ploughs: Dilemmas of household response sequencing during food shortages.* Institute for Development Studies Bulletin 24:29-43.

DFID, (1999). Sustainable Livelihoods Guidance Sheets. Department for International Development. www.livelihood.org/info/info_guidancesheets.htm.Dire Dawa, Eastern Ethiopia. *African Journal of Food and Agriculture, Nutrition and Development.*

Doss, C.R. (2006). "The Effects of Intrahousehold Property Ownership on Expenditure Patterns in Ghana." *Journal of African Economies 15* (1): 149–180.

Else, A. (1999). *Hidden hunger: food and low income in New Zealand*. Wellington: New Zealand Network Against Food Poverty. Available from:http://www.standrews.org.nz/dcm/research/hiddenhunger.pdf Accessed 14.07.09

Ellis, F. (1998). Household Strategies and Rural Livelihood Diversification, *Journal of Development Studies*, Vol. 35, No.1, pp.1-38.

Ellis, F. (2000), *Peasant Economics, Farm Household and Agrarian Development*, Newcastle: Cambridge University Press.

Esson, K. M., and Leeder, S. R. (2004). *The millennium development goals and tobacco control: an opportunity for global partnership*. Geneva, Switzerland, World Health Organization.

Elwell, H. A. (1994) "An Assessment of Soil Erosion in Zimbabwe," *The Zimbabwe Science News*, Vol. 19, No. 3/4, pp. 27-31.

Farm Management Handbook of Kenya (2007) Vol. II– Natural Conditions and Farm Management Information –2nd Edition part A, B and C. German Agency for Technical Cooperation (GTZ). Nairobi. Kenya.

Famine Early Warning Systems (FEWS), (1995). *Current vulnerability assessment.* Report on Kenya.

Fan, S., Joanna, B., Michiel, K. and Halsema, A. (2013). '*From Subsistence to Profit: Transforming Smallholder Farms'.* Washington, DC: International Food Policy Research Institute. Available at: http://www.ifpri.org/publication/subsistence-profit.

FAO (2014) *The State of Food Insecurity in the World: Strengthening the Enabling Environment for Food Security and Nutrition*, Rome: FAO, Available at: http://www.fao.org/3/a-i4030e.pdf

FAO and WFP, (2009). *The State of Food Insecurity in the World 2009*. Economic crises – impacts and lessons learned. Rome, FAO.

FAO, (1982). *The State of Food and Agriculture 1981*.Food and Agriculture Organization of the United Nations, Rome.

FAO (2003), *Trade Reforms and Food Security*. Commodities and Trade Division, Rome.

FAO (2006). The State of Food and Agriculture 2006. Food Aid for Food Security? Food and Agriculture Organization of the United Nations, Rome.

FAO, (2013). *The Millennium Development Goals: The Road Ahead*. Available online: www.fao.org/mdg/ (Accessed on 12 February 2013).

FAO (2016). *Crop Prospects and Food Situation* and other GIEWS reports are available online at: http:/www.fao.org/giews/.In addition, GIEWS *Special Reports* and *Special Alerts*, available at: http:/www.fao.org/giews/english/listserv.htm.

FAO, AHP, (2002) *Anti-Hunger Programme: Reducing hunger through agriculture and rural development and wider access to food*, FAO, Rome.

FAO, IFAD, and WFP. 2013. *The State of Food Insecurity in the World 2013: The Multiple Dimensions of Food Security*. Rome: Food and Agriculture Organization of the United Nations. Available at: http://www.fao.org/docrep/018/i3434e/i3434e00.htm.

FAO/FSAU and Save the Children (UK) (2002). Partnership Household Food Security and Livelihoods Project. Concept Paper. 25 March for the 21st Century. IDS Discussion Paper 296, IDS, Brighton, UK.

FAOSTAT (2007): Statistics Database of the United nations Food and Agriculture Organization, FAO, Rome.

FAOSTAT. (2014) Food and Agricultural Organization of the United Nations (FAO), FAO Statistical Database, 2014, from http://faostat.fao.org

FAOSTAT. (2015). Statistical databases and data-sets of the Food and Agriculture Organization of the United Nations. http://faostat.fao.org/default.aspx. Accessed 02 Jan 2015.

Fawehinmi, O. A. and Adeniyi, O.R. (2014). *Gender Dimensions of Food Security Status of Households in Oyi State, Nigeria.* Global Journal of Human Social Science: H Interdisciplinary Volume 14 Issue 1 Version 1.0.

Famine Early Warning Systems Network (FEWS NET), (2011).*Ethiopia Food Security Outlook Update, August 25, 2011*. Available at: http://www.fews.net/docs/Publications/Ethiopia_Dekadal_08_20_final_ext.pdf

Food and Agricultural Organization of the United Nations. (FAO). **(**2009a**.)** Rural Income Generating Activities database (available at www.fao.org/es/ESA/riga/ english/index_en.htm).

Food and Agricultural Organization of the United Nations. (FAO). (2009b). WorldSummit on Food Security, Rome, November 16–18, *Background Paper —Feeding the World, Eradicating Hunger*. Retrieved from:ftp://ftp.fao.org/docrep/fao/Meeting/018/k6077e.pdf

Garratt Glass, E (2015). *CSI 13 Food Insecurity & Food Bank Use*, Briefing Note for Oxford University (April 2015).

Garthwaite, K A, Collins, P J & Bambra, C (2015). Food for thought: An ethnographic study of negotiating ill health and food insecurity in a UK food bank. *Social Science & Medicine* 132 38-44.

Gebrehiwot ,T. and Van der Veen A. (2010). *Effect of policy interventions on food security in Tigray, Northern Ethiopia.* University of Twente Faculty of Geo-Information Science and Earth Observation, Netherlands. Working Papers Series - Paper 6

Geist, H. (1997). *"How tobacco farming contributes to tropical deforestation*." Paper presented at the Tobacco Deliberation Group Meeting, National Committee for International Cooperation and Sustainable Development, Utrecht, 29 October 1997.

Global Food Security, (2016) *Food Systems Dialogue: A GFS Food Futures panel activity*. OPM Group for the Global Food Security Programme, January 2016. [Draft]

Global Policy Institute (Glopolis), (2013). *Food Security and Agricultural Trade in Kenya: The Impact of the Economic Partnership Agreement (EPA) on Food Security of Poor Kenyans*, Prague Global Policy Institute-Glopolis.

Godwin, R. J. (1990). *Agricultural Engineering in Development:* Tillage for Crop Production in Areas of Low Rainfall, vol. 83, FAO Agricultural Services Bulletin, Rome, Italy.

GoK, (1986). "*Economic management for renewed growth*". Sessional Paper No. 1 of 1986. Nairobi: Government Printer. Kenya

….., (2002). "*Special Report: Eritrea",* FAO/WFP Crop and Food Supply.

….., (2009a). *Declaration of the World Summit on Food Security, WSFS 2009/2, 16th November, 2009, Rome.*

……., (2009b). *Bridging the Gap: FAO's Programme for Gender Equality in Agriculture and Rural Development*, Rome: FAO.

……., (2014). *Press release - UN General Assembly's Open Working Group proposes sustainable , development goals*, 19. July 2014.

……, (2000b). *The Second Report of Poverty in Kenya. Vol. 1. Incidence and Development of Poverty*. Nairobi: Government Printers.

……, (2003a). *The State of Food Insecurity in the World. Monitoring progress towards the World Summit and Millennium Development Goals*.

……, (2010). *Kenya Economic survey. Kenya National Bureau of Statistics, Ministry of Planning, National Development and Vision 2030*, Nairobi.

……, (2011). *National Food and Nutritional Security Policy, Nairobi:* Agricultural Sector Coordination Unit.

……, (2013). *Kenya National Bureau for Statistics*. Nairobi: Government Printers.

……, (1983). *World Food Security: a Reappraisal of the Concepts and Approaches. Director Generals Report*, Rome.

……, (1996): *World Food Summit*, Corporate Document Repository, FAO, Rome

……, (1999). *North and South Gender - Food security assessment in parts of the Tekeze River Watershed*. United Nations Development Programme, Emergencies Unit for Ethiopia, Assessment Mission: May 26-June 7, 1999, Addis Ababa, Ethiopia.

……, (2002). *The state of food insecurity in the world*, 2002.FAO, Rome.

……, (2004). *The state of food insecurity in the World.* Monitoring progress towards the World Food Summit and Millennium Development Goals. FAO. Rome.

……, (2008). *Crop prospects and food situation*, No 2 July Rome.

……, (2012). "*Towards the future we want, end hunger and make the transition to sustainable Agricultural and food systems*". Rome.

……, (2012). *The State of Food Insecurity in the World: Economic Growth is Necessary but Not Sufficient to Accelerate Reduction of Hunger and Malnutrition*, Rome: FAO, http://www.fao.org/docrep/016/i3027e/i3027e.pdf

……, (2013). *State of food insecurity in the world: the Multiple Dimensions of Food Insecurity*, Rome: FAO.

……, (2014). *Food Security Research Findings and Recommendations*. Migori County Nairobi, Kenya.

……, (2014). *The State of Food Insecurity in the World: Strengthening the Enabling Environment for Food Security and Nutrition*, Rome: FAO, http://www.fao.org/3/a-i4030e.pdf.

……, (2015). *"Transforming our world: the 2030 Agenda for Sustainable Development"*. United Nations - Sustainable Development knowledge platform. Retrieved 23 August 2015.

……., (2000a). The Interim Poverty Reduction Strategy Paper 2000-2003. Preliminary Draft. Nairobi: Government Printer.

……., (2008). *Kenya Food Security and Nutrition Strategy.* Nairobi: Government Printers.

……., Kuria East District Development Plan (2008-2012). Nairobi: Government printer.

…….,(2000). *The Elimination of Food Insecurity in the Horn of Africa – Summary Report*. Rome: Food and Agriculture Organization. Accessed on October 11, 2011 at: http://www.fao.org/docrep/003/x8530e/x8530e00.htm

……., (2003a). *Trade Reforms and Food Security*. Commodities and Trade Division, Rome.

……., (2003b). *An Inter-Agency Initiative to promote Information and Mapping Systems on Food Insecurity and vulnerability.* Proceedings 66 on Measurement and Assessment of Food deprivation and under nutrition. International Scientific Symposium, Rome, 26 – 28 June 2002.

……., (2004). *Strategy for Revitalizing Agriculture 2004-2014*, Nairobi, Kenya: Ministry of Agriculture.

……., (2005). *Eradicating World hunger, key to achieving the millennium development goals*.

……., (2006). *The State of Food Insecurity in the World*. Eradicating world hunger –taking stock ten years after the World Food Summit.

……..,Census (2009). *Kenya National Bureau of Statistics: 2009 Kenya Population and Housing Census Volume 1A*. Nairobi: Government Printers. Kenya.

……., *Migori County Development Profile (2013).* Nairobi: Government printer. Kenya

……..,*Migori County First County Integrated Development Plan (2013-2017).* Nairobi: Government printer. Kenya.

Govereh, J. and Nyoro, J. (1999). *Smallholder Commercialization, Interlinked Markets and Food Productivity*: Cross-Country Evidence in Eastern and Southern Africa. Michigan State University, Michigan, USA.

Guendel, S. (2009). *'What are "women's crops", and why?' Gender Insight*, Rome: FAO, www.fao.org/gender/gender-home/gender-insight/gender-insightdet/en/c/36003/

Guerena T., Kimetu J., Riha S., Neufeldt H. and Lehmann J. (2016). *Maize productivity dynamics in response to mineral nutrient additions and legacy organic soil inputs of contrasting quality.*" Field Crops Research.

Gustafson & Daniel J. (2013). *Rising food costs and Global food security:* key issues and relevance for India.

Gyamfi S. (2006). *Food security in Ghana*: *the development and diffusion of appropriate technologies,* Ghana Statistical Service.

Haile, H. K., Alemu .G. and Kudhlande, G. (2005): *Causes of household food insecurity in Koredegaga peasant association, Oromiya zone, Ethiopia,* Working paper, Department of Agricultural Economics, Faculty of Agricultural Sciences, University of the Free States.

Hofferth, S.L. (2003). *Persistence and Change in the Food Security of Families with Children, 1997-1999.* Department of Family Studies, University of Maryland. Availableonline:http://www.findarticles.com/p/articles/mi_m1309/is_3_40/ai_111027115http://exploringafrica.matrix.msu.edu/students/curriculum/m9/activity2.php.

Hoogmoed, W. B. and Klaij, M.C. (1990). *Soil management for crop production in the West Africa Sahel soil and climate parameters*; soil and Tillage Research 16:85-103.http://www.drtomoconnor.com/3760/3760lect04.htm. (Accessed on 17/7/2011).

Hossner, L.R, Juo, A.S.R. (1999). *Soil Nutrient Management for Sustained Food crop Production in Upland Farming Systems in the Tropics.* Juo Soil and Crop Sciences Department College Station Tennessee 77843, USA. Retrieved from http//www.agnet.org

IFAD (2013). 'Food Security - a Conceptual Framework'. IFAD website: IFAD. Available at: http://www.ifad.org/hfs/thematic/rural/rural_2.htm.

IFPRI, (2002). *Reaching sustainable Food security for all (2020). Getting the priorities and responsibilities right*. Washington, D.C: IFPRI Committee on World Food Security.

IFPRI, (2009). *Climate Change: Impact on Agriculture and Costs of Adaptation.* Washington D.C 2006-1002. USA. *Income and Nutritional Effects in Developing Countries'.* 1. Working Papers on Commercialization of Agriculture and Nutrition. Washington D.C.: IFPRI. pp 59.

Intergovernmental Panel on Climate Change (IPCC), (2007). Summary for Policy Makers on Climate Change 2007: Synthesis Report. Published for IPCC. Cambridge: Cambridge University Press. UK.

IPCC (2000). "*Climate Change 2001: Impacts, Adaptation, and Vulnerability*". Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK.

Irungu, P., Ndirangu L. and Omiti J., (2009). *Social Protection and Agricultural Development in Kenya.* Future Agricultures Working Paper 005. Available at agricultures.org

Jätzold, R. and Schmidt, H. (1982): Farm management handbook of Kenya. - Vol. II, Part A, Rossdorf/Nairobi

Jayne, T.S., and Argwings-Kodhek, G. (1997). "Consumer Response to Maize Market Liberalization in Urban Kenya."*Food Policy*, Vol.22.No.5.

Jayne, T.S., Mather, D. and Mghenyi, E. (2010) Principal Challenges Confronting Smallholder Agriculture in Sub-Saharan Africa. World Development, 38, 1384-1398. http://dx.doi.org/10.1016/j.worlddev.2010.06.002.

Jennings, S. and Magrath, J. (2009). Suffering the Science: Climate change, people and poverty, Oxfam.

Jerneck, A. and Olsson, L., (2014). Food first! Theorising assets and actors in agroforestry: risk evaders, opportunity seekers and 'the food imperative' in sub-Saharan Africa. *International Journal of agricultural sustainability, 12* (1), 1–22.

Jiggins, J. (1986). "*Women's Access to Land in sub-Saharan Africa: Issues for Discussion*." Paper prepared for ILO Regional Workshop on Women's Access to Land. Geneva: International Labour Organization.

Kabubo-Mariara J. and Karanja, F. K., (2007). *The Economic Impact of Climate Change on Kenyan Crop Agriculture: A Ricardian Approach. Global and Planetary Change 57:319 330, 2007. Ninth Annual Global Development Conference "Security for Development: Confronting Threats to Survival and Safety*"; Brisbane, Australia. January 29-31, 2007.

Kairaba, A. (2002). *"Rwanda Country Case Study",* paper presented at the Regional Workshop on Land Issues in Africa and the Middle East, Kampala, Uganda, 29 April-2 May 2002.

Kaloi, E., Tayebwa, B. and Bashaasha, B. (2005*):* Food security status of households in Mwingi District, Kenya .Department of Agricultural Economics and Agribusiness, Makerere University, Kampala, Uganda. *African Crop Science Conference Proceedings*, Vol. 7. pp. 867-873.

Kang'ara J. N., Ngoroi, E. H., Muturi, J. M., Amboga, S. A., Ngugi, F. K. & Mwangi, I. (2001). *The role of livestock in soil no fertility, biodiversity, land use, cultural and welfare change* in Nduuri Embu, Kenya.

Kasanga, K. (2001). *Land Resource Management for Agricultural Development in Ghana,* London: RICS Foundation.

Kassa, H., Gibbon, D. and Singh, B.P. (2002). Livestock Improve Household Food Security and Sustainability of Ethiopian Small Farms. *Journal of Sustainable Agriculture* 21(2):35:36.

Kathuri, N. J. and Pals, A. D. (1993). *Introduction to educational research.* Education Media Centre Egerton University.

Katz, E. (2002). Innovative Approaches to Financing Extension for Agriculture and Natural Resource Management: Conceptual considerations and analysis of experience. LBL.

Kennedy, E. and Peters, P. (1992): *Household Food Security and Child Nutrition:* The Interaction of Income and Gender of Household Head World Development, 20 (8) 1077-1085.

Kenya Maize Handbook. (2009). *Kenya Market Development Programme*. Nairobi Kenya: Government of Kenya.

Kenya National Bureau of Statistics (KNBS) (2012). *Kenya facts and figures 2012*. Nairobi: KNB

Kilonzi, T. M. (2013). *Enhancing Food Security Through Policy Re-Orientation in Laikipia Central, Kenya.* International Journal of Humanities and Social Science, 3(12), pp. 107-116.

Kimenju, J., Singo M. & Wairagu, F. (2003). *Terrorized Citizens: Profiling Small Arms and Insecurity in the North Rift region of Kenya*. Nairobi.

Kimenju, S. and Schirley. T. D. (2008). *Agriculture and Livelihood Diversification in Kenyan Rural Households*. Tegemeo Working Paper No. 29. Nairobi: Tegemeo Institute of Agricultural Policy and Development, Egerton University. Online at: www.tegemeo.org.

Kisii Metrological Station, (2015)

Kiptot, E. and Franzel, S. (2011). *Gender and Agroforestry in Africa: are Women Participating? ICRAF Occasional Paper No. 13*. Nairobi: World Agroforestry Centre. Available at:http://www.worldagroforestry.org/downloads/publications/PDFs/OP16988.pdf

Kirimi, L., Gitau, R., and Olunga, M., (2013). *Household Food Security and Commercialization among Smallholder Farmers in Kenya.* Available at: www.ageconsearch.umn.edu/..0millicent%20lunga.pdf.

Klasen, S. (2002). *Does Gender Inequality in Education Reduce Growth and Development?* Evidence from County Regressions. World Bank Economic Review. Washington DC.

Kormawa, P., Okike, I., Okechukwu, R. and Akande, S.O. (2003).*African Food Crisis* – The Nigerian Case Study. African project. International Institute of Tropical Agriculture. Nigeria.

KFFSG. (Kenya group food security steering group), (2009). *The market study Report.* Available at:http://www.kenyafoodsecurity.org

Kumba, J. K., Wegulo, F. N. and Otieno, J., (2015a). The Influence of Agricultural Land Use on Household Food Security Situation in Kisii Central sub-County, Kenya. *Economics and Sustainable Development* 6(6):147 – 152.

Kumba, J. K. (2015b). *The Influence of Agricultural Land Use on Household Food Security Situation in Kisii Central sub-County, Kenya.* Unpublished PhD Thesis Egerton University.

Landesa, W. A. (2012). *Land Rights and Food Security: the linkages Between Secure Land Rights, Women and Improved Household Security and Nutrition*, Issues Brief, Seattle, WA: Landesa, www.landesa.org/wp-content/uploads/Landesa-Issue-Brief-Land-Rights-and-Food- Security.pdf 84

Legesse, B. and Drake, L. (2005). Determinants of smallholder farmers' perceptions of risk in the Eastern Highlands of Ethiopia. *Journal of risk research.* Routledge Informa Ltd. UK.

Lugairi, E. (2004). *Food insecurity in Sabatia Division of Vihiga District, Western Kenya: An examination of households' coping strategies*. Unpublished MA Thesis Egerton University.

Maina, I., Newsham, A. and Okoti, M. (2013). *Agriculture and Climate Change in Kenya:* Climate Chaos, Policy Dilemmas, Brighton: Future Agricultures.

Makoye, K. (2012).*Tobacco farms drive major deforestation in Tanzania*. Accessed online at:http://www.trust.org/alertnet/news/tobacco-farms-drive-major-deforestation-in-tanzania/

Malangu, F., Depetris, N., Chauvin and Duido, P. (2012).*Food production and consumption in Africa: Prospects for transformation of agricultural sector*. Regional Bureau for Africa page 7.

Mamba S.F., Salam A., Peter G. (2015). *Farmers' Perception of Climate Change a Case Study in Swaziland.* Journal of Food Security 3: 47-61.

Maxwell, S. and Fernando, A. (1989). *Cash cropping in developing countries: The issues, the facts, the policies.* World Development, Vol. 17 (11), 1677-1708.

Maxwell S. & Frankenberger T. (1992**)**. *Household food security, concepts, indicators and measurements: a technical review*. UNICEF/IFAD, New York/Rome.

Maxwell, S. (2008). "*The Coping Strategies Index: A tools for rapid measurements of household food security and the impact of food aid programs in humanitarian emergencies",* Field Methods Manuals 2nd Edition January 2008.

Maxwell, S. and Simon, M. (2012). *"Food Policy Old and New". Development Policy Review*.doi:10.1111/j.1467-8659.2003.00222.x.

Mbithi, L.M. (2000). *Effects of agricultural policy on maize production in Kenya* .PhD. thesis University of Gent.

Mekonnen, T. (2000).*Determinants and Dynamics of Urban Poverty Ethiopian, journal of Economics.* Addis Ababa.

Minot, N. and Vargas, H.R. (2007). Developing and connecting markets for poor farmers, IFPRI, Washington DC.

McLaren, W. (2007) *Smoking: Environmental and social impacts.* Available online Available at:http://www.treehugger.com/green-food/smoking-environmental-and-social-impacts.html proctor, RN, pg. 516

MoA and Livestock Development (2003). Department of Agricultural Extension. *Kenya's Special Programme for Food Security: Concept Note*. Nairobi, Kenya.

MoA, (2005). *Kenya Strategy for Revitalizing Agriculture (2004-2014),* Nairobi Government Printer. Kenya.

MoA, (2013). Report on cross trade between Kenya and Tanzania. Government Printer. Kenya.

Morris, M. L. (2000). Assessing the Benefits of International Breeding Research: An Overview of Global Maize Impacts Study. CIMMYT World Maize Facts and Trends, CIMMYT, Mexico C. F., 25-34 [updates of recent breeding results and their impact on yield]

Mose, L.O, Burger, K and Kuvyenhoven, A. (2007), "Aggregate supply response to price incentives: The case of smallholder maize production in Kenya", Africa crop science conference proceedings in Egypt: *Africa Crop Science Society,* Vol. 8, 1271-1275.

Moyo, S. (2000) "The Land Question and Land Reform in Southern Africa", work in progress. Land Tenure, Madison: Africa Land Tenure Center, University of Winsconsin: 164-168.

Moyo, S., Robinson, P., Katerere, S., Stevenson, Y., and Gombo, S. (1991). *Zimbabwe's Environmental Dilemma.* Balancing Resource Inequities, ZERO, Harare, Zimbabwe.

Mukudi, E. (2003). "Education and Nutrition Linkages in Africa: Evidence from National Level Analysis." *International Journal of Educational Development 23 (3) (May):* 245–256.

Mwale, M. (1998). *Effects of application of jesban pruning on maize yields in: the biology and fertility of tropical soils.* TSBF, Report, Nairobi.

Najafi, B. (2003). *An Overview of Current Land Utilization Systems and Their Contribution to Agricultural Productivity*. Report of the APO Seminar on Impact of Land Utilization Systems on Environmental Change Unit, University of Oxford.

Nunnally, J. (1978). *Psychometric theory*. New York: McGraw-Hill.

Nunow, A. A. (2000). *Pastoralists and markets: Livestock commercialization and food security in North-eastern Kenya. PhD thesis,* university of Amsterdam.

Nyangito, H. and Okello J. (1998). Kenya's Agricultural Policy and Sector Performance: 1964-1996, IPAR, Occasional Paper No. 04.

Nyangito, H.O. (1999). *Agriculture Sector Performance in a changing policy environment. In Kenya's policies for the 21st Century.* Institute for Policy Analysis and Research.

Ochieng', R. (2013). Rainfall variability and Adaptation Mechanisms by Smallholder Farmers in Kwale County: A case Study of Samburu and Tsimba Location. Unpublished MA Thesis. Egerton University.

O'Connor, T. (2011). *Survey Research Design: Mega Links in Criminal Justice*. http://www.drtomoconnor.com/3760/3760lect04.htm. (Accessed on 17/7/2011).

Oluwatayo, I. B. (2008). Explaining Inequality and Welfare Status of Households in Rural Nigeria: Evidence from Ekiti State. *Humanity and Social Sciences Journal*, 3 (1): 70-80, 2008.

Olwande, J. and Mathenge, M. (2010). *Market participation among poor Rural Households in Kenya.* (Forthcoming) working paper No. 42/2011.Tegemeo Institute of Agricultural Policy and Development, Nairobi. Egerton University.

Olwande, J., and Mathenge, M. (2010). *Market Participation among Poor Rural Households in Kenya*. Forthcoming Working Paper No. 42/2011. Tegemeo Institute of Agricultural Policy and Development, Nairobi.

Oneworld.net (us), (2009). Europeans fish for biofuels in Senegal. See:

www.uk.oneworld.net/article/view/164713/1/1912 (accessed January 2010).

Oongo E. O. (2004): *Tobacco Growing in Kenya: Viable Alternative Income Generating Activities For Farmers, p 2.* KATOGA Publication. Nairobi.

Oskam, A.J. (1995). *Different approaches in analyzing agricultural policy*. Wageningen Agricultural University, Wageningen: CABI Publishing, pp.191–216.

Osman, A and Tesfahun, F. (2003). Challenges and Properties of Food Security in Ethiopia: Proceeding of Food Security Conference in 2003, Professional Association of Joint Secretariat. In: *Proceedings of the food security conference*. UNNCC, Addis Ababa, Ethiopia, 13–15 August.

Paddy F. (2003). *Gender differentials in land ownership and their impact on household food security: a case study of Masaka district*. Master thesis. Uganda. Available at:http://www.troz.uni-hohenheim.de/research/Thesis/MScAES/Paddy.pdf.

Palmer, R. (2000). "*The Struggles Continue: Evolving Land Policy and Tenure Reforms in Africa – Recent Policy and Implementation Process"* in Toulmin, C. and Quan, J. (2000) Evolving Land Rights, Tenure and Policy in sub-Saharan Africa, London: IIED and NRI.

Pardey, P.G. and Alston, J.M. (1995). *Revamping agricultural R&D*. Washington, DC, International Food Policy Research Institute (IFPRI).

Pimentel, D., (2006). *Soil Erosion: A Food and Environmental Threat*. Environment, Development and Sustainability 8: 119–137.

Pingali, P., Alinovi, L. and Sutton, J. (2005). Food security in complex emergencies: enhancing food system resilience. *Disasters, 29* (S1): S5–S24.

Place, F. and Otsaka, K. (2001). *Land Tenure and Natural Resource Management: A Comparative Study of Agrarian Communities in Asia and Africa*, Baltimore: Johns Hopkins University Press.

Price Waterhouse Coopers (2001). *The Zimbabwe Tobacco Industry, An Economic Analysis,* Economic Studies and Strategies Unit Cariberra.

Qamar, M.K. (2002). *Global trends in agricultural extension: Challenges facing Asia and the Pacific region; FAO Regional Expert Consultation on Agricultural Extension* (Bangkok, July 2002). FAO. Rome.

Quan, J. (2000).*"Land Tenure, Economic Growth and Poverty in sub-Saharan Africa."*

Republic of Kenya, Ministry of Public Health and Sanitation. (2012). *National Nutrition Action Plan 2012–2017*. Nairobi: Government Printing Press.

Republic of Kenya. (2011). *National Food and Nutrition Security Policy*. Nairobi: Government Printers. Kenya.

Rosegrant, M.W., Paisnerr M.S., Meijer S., Witcover, J. (2005).2020 *Global Food Outlook: Emerging Trends, and Future Alternatives*. IFPRI, Washington**.**

Rosenzweig, M. R. (1995). Why are there returns to schooling? *AER: Papers and Proceedings of the American Economics Association, 85, 153-158.*

Rutsch, H. (2003). *The role of sustainable fertilization*: Global food security. Available online: http://www.un.org/Pubs/chronicle/2003/issue3/030.

Saber, M. (2009). Environment in Jeopardy: Consequences of Climate Change in Egypt. *Journal of Ecology and the Natural Environment*, 1(5), 191-195.

Sah, R.P. (2002). *Sustainable livelihoods and poverty alleviation: Case study in improving food security and livelihood of mountain people through development of agriculture*. A paper presented at international seminar on mountains (ISM), Kathmandu, Nepal March 6th -8th, 2002.

Salojee Y, (2007). *Chronic Diseases of Lifestyle in South Africa: Tobacco Control in South p.48-56.* Criminal Defence Law Students Association (CDLSA) Publication. Cape Town.

Schafer, J. (2002). *Supporting Livelihoods in Situations of Chronic Conflict and Political Instability: Overview of Conceptual Issues*. Working Paper 183, Livelihoods and Chronic Conflict Working Paper Series. London: Overseas Development Institute.

Scoones, I. (1998). *Sustainable rural livelihoods: A Framework for Analysis*. Institute of Development Studies working paper.

Seitz, J. and Nyangena, W. (2009). *Economic Impact of Climate Change in the East African Community (EAC).* Final Report, 14 August 2009. GTZ/EAC.

Sheahan, M. and Barrett C. B. (2014). *Understanding the agricultural input landscape in Sub-Saharan Africa: recent plot, household, and community-level evidence*." Policy Research Working Paper WPS7014, The World Bank (WB), Washington, D.C.

Shisanya, C. A. and Khayesi, M. (2007). How is Climate Change perceived in relation to other socioeconomic and Environmental threats in Nairobi, Kenya? *Climate change*, 85, 271-284.

Sikoyo, G.M., Ochieng, O. D. and Kameri-Mobte, P. (2002). *The Impacts of Globalisation* in Food Security and Land Resources Rights in Africa,

Sikwela, M. M. (2008). *Determinants of Household Food security in the semi-arid areas of Zimbabwe:* A case study of irrigation and non-irrigation farmers in Lupane and Hwange Districts. Unpublished Thesis for the degree of Master of Science in Agriculture. Department of Agricultural Economics and Extension. University of Fort Hare, Republic of South Africa

Skalness, A. (1995). *The Politics of Economic Reform in Zimbabwe*, New York: St Martin's Press.

Smith, H. and Huang, Y. (2000**)**. *Achieving food security in North Korea***.** Australian National University. Available at:http://www.mi.infn.it/~landnet/corea/proc/039.pdf.

Smithers, J. and Smit, B. (2009).Human Adaptation to Climatic Variability and Change. In L. E. Schipper and Burton I. (Eds.), *Adaptation to Climate Change* (pp. 15-33). London: Earthscan. St. Martin's Press.

Sseguya, H. (2009). *Impact of social capital on food security in southeast Uganda.* (Ph.D. dissertation Department of Sociology, Iowa State University, Ames, USA

Stamm, V., 2000. *The Rural Land Plan: An innovative approach from Côte d'Ivoire*, Issue Paper No. 91, International Institute for Environment and Development, UK.

Stamoulis, KG., Pingali, P & Shetty, P. "*Emerging challenges for food and nutrition policy in developing countries"* Special issues on "Globalization of food systems: Impact on food security and nutrition" electronic *Journal of Agricultural and Development Economics*, *eJADE*1(2): 154-167, (2004) available on line at: www.fao.org/es/esa/eJADE

Stephen, D. S. (2000). *Food security in Ethiopia*. A discussion paper for Department for International Development, Institute of Development Studies Sussex.

Submarian, J. (1996). "*Eritrea Country Profile" in Bruce, J. W. (1996) Country Profiles of* Swiss Centre for Agricultural Extension, Eschikon 28, CH-8315 Lindau, and Switzerland Kenya National Bureau of Statistics (2007) Basic Report on well-being in Kenya.

Taeb, M. (2004). *Agriculture for Peace*: Promoting Agricultural Development in Support of Peace. United Nations University-Institute of Advanced Studies, Japan, Available at: http://www.ias.unu.edu/binaries/UNUIAS_AgforPeaceReport.pdf.

The International Institute for Sustainable Development, (2003). *Livelihoods and Climate Change*, Unigraphics, Winnipeg.

Thomas R. & Leatherman T. (1990). *Household Coping strategies and Contradictions in Response to Seasonal Food Shortage*. European Journal of Clinical Nutrition 44(1):103-111.

Timmer, C. and Peter, P. (1983). *Food Policy Analysis*. The World Bank. Available at: http://iis-db.stanford.edu/pubs/10361/Food_Policy_Analysis.pdf*Urban Centers of Ethiopia*. UNICEF, Addis Ababa, 2009.

Todd, B. (2004). *Africans Food and Nutrition Security Situation*. Where are we and how did we get here? 2020 Discussion Paper 37, 2. Washington D. C.: IFDRI.

Toulmin, C. and Quan, J. (2000). *Evolving Land Rights, Tenure and Policy in sub-Saharan Africa: 31-49.*

UN, (2013). *The Future We Want*, Outcome document of the United Nations Conference on Sustainable Development, retrieved 26 February 2013.Available at: http://www.un.org/en/sustainablefuture

United States Agency for International Development (USAID). (1992). "*Policy Determination 19, Definition of Food Security*", April 13, 1992. Washington, DC, 1992.

USAID, (2003). *Analyses is of Food Security, Health and Nutrition*. Report in Zambia; February 2003.Volume 9, No 9.

Van Der Veen, A., and Tagel, G., (2011). Effect of Policy Interventions on Food Security in Tigray, Northern Ethiopia. *Ecology and Society* 16(1):18 available at:http://www.ecologyandsociety.or/vol16/iss1/art18/

Vanlauwe, B., Six, J., Sanginga, N. and Adesina A. A. (2015). Soil fertility decline at the base of rural poverty in sub-Saharan Africa." *Nature Plants, 1*(7): p. 15101.

Von Braun, J. and Kennedy, E. (1986). '*Commercialization of Subsistence Agriculture: Income and Nutritional Effects in Developing Countries'.* 1. Working Papers on Commercialization of Agriculture and Nutrition. Washington D.C.: IFPRI.

Von Braun, J. and Kennedy, E. (Eds). (1994). *Agricultural Commercialization, Economic Development and Nutrition*. Johns Hopkins University Press, Baltimore, Maryland.

Von Braun, J., Hazell, P., Hoddinot, J. and Babu, S. (2003). *Achieving Long Term Food Security in Southern Africa:* International Perspectives, Investment strategies and lessons. International Food Policy Research Institute (IFPRI).Washington

Wang, E., van Osterom, E., Meinke, H., Asseng, S., Robertson, M., Huth, N., Keating, B. and Probert M. (2003) *The new APSIM-Wheat Model performance and future improvements. In Solutions for a better environment*. Poster 2. *In* Proc. of the Aust. Agron. Conf., 11th, Geelong, Australia. 2–6 Feb. 2003. Aust. Soc. of Agron., Geelong, Australia.

Wehbe, M., Eakin, H., Seiler R., Vinocour, M., Avila, C. and Marutto, C. (2006). *Local perspectives on adaptation to Climate change*: Lessons from Mexico and Argentina. AIACC working paper no. 39. USA.

White, P. (2005). *War and food security in Eritrea and Ethiopia.* In: Disasters 29 (1): 92-113.

World Bank, (2007). *Accelerating Equitable Growth*, Ethiopia Country Economic No.38662-Momerandum, Poverty Reduction and Economic Management Unit Africa Region.

World Bank, (2009). "*Gender and Food Security*." *In Gender in Agriculture*: Sourcebook World bank Publications. Available at: http://books.google.com/books?

World Commission on Environment and Development, (1987). *Our Common Future.* Brundtland and Gro Harlem, (ed.) Oxford University Press, Oxford. 400pp.

World Food Programme, (2009). *Kenya Food Security Update.* World Food Programme, New Yolk.

World Health Organisation Technical Report Series No. 955 (2009). *WHO Study Group on Tobacco Product Regulation: Third Report of a WHO Group;* Geneva, Switzerland.

Zeng, D., Alwang, J., Norton, G. W., Shiferaw, B., Jaleta, M. and Yirga, C. (2013). Ex post impacts of improved maize varieties on poverty in rural Ethiopia. Agricultural Economics. 46 (4): 1–12.

APPENDICES

APPENDIX A

FARMERS QUESTIONNAIRE

I am a student of Egerton University pursuing Masters of Science Degree in Geography. This is an academic study whose main purpose is to collect data about determinants of food production. These questions are for research purposes only. The information you provide will be treated with utmost confidentiality. Your assistance in answering the questions truthfully and accurately will be highly appreciated.

Division……Location……Sub-location……

PART A: <u>Personal details</u>

Indicate the following information about yourself. Please tick the appropriate choice or fill in the blanks appropriately. Like [√]

(a) Sex: i. Male [ ]

ii. Female [ ]

(b)Education level

i. Primary [ ]

ii. Secondary [ ]

iii. Tertiary [ ]

(c)Age bracket

i. 18-30 [ ]

ii. 31-40 [ ]

iii. 41-50 [ ]

iv. 51+ [ ]

(d) What is the size of your household?

i. 0-2 ☐

ii. 2-4 ☐

iii. Above 5 ☐

(e) Approximate land area under food production in acres

i. 0.1-1.0 ☐

ii. 1.1-2.0 ☐

iii. 2.1-3.0 ☐

iv. above 3.1 ☐

(f) Who is the decision maker in your household?

(i) Father ☐

(ii) Mother ☐

React on the following statements about soil quality

Statement	**Response**				
	SA	A	NC	DA	SDA
I have sufficient fertile soil for my agricultural needs					
The soil in this area is moderately fertile. I always get good return from it					
in this area soil is infertile and does not hold water for a long time					
I use inorganic fertilizers to improve soil fertility					

Key: SA=Strongly Agree (5)**; A=**Agree (4)**; NC=** No Comment (3)**; DA=** Disagree (2)**; SDA=** Strongly Disagree (1)

React on the following statements about rainfall variability

Statement	Response				
	SA	A	NC	DA	SDA
The rainfall in my area is very reliable and predictable. Rains never fail.					
It always rains satisfactorily during the short rain season from September to December every year.					
It always rains satisfactorily during the long rain season from February to July every year.					
Drought in my area always interferes with agricultural production.					

Key: SA=Strongly Agree (5)**; A=**Agree (4)**; NC=** No Comment (3)**; DA=** Disagree (2)**;**

SDA= Strongly Disagree (1)

Other agricultural land use practices that affect food production

a) Apart from food crop farming do you carry out any other agricultural practices?

No ☐ Yes ☐

b) If yes which one

Tobacco growing ☐ Livestock keeping ☐ Coffee farming ☐ others ☐

c) Does this other agricultural practice (s) enable you access food?

No ☐ Yes ☐

d) If yes do you sell or exchange tobacco, livestock or coffee for food?

No ☐ Yes ☐

The current food status and mitigation measures that farmers use to overcome the problems of food insecurity

Current food status in the study area

a) After every maize harvest, do you get enough yields to take you up to the next season?

No ☐ Yes ☐

If no which mitigation measures among the following do you use to overcome the problems of food insecurity.

a) I sometimes buy food from other farmers for use in my household.

No ☐ Yes ☐

b) I sometimes borrow food from my neighbours/relatives

No ☐ Yes ☐

c) I sometimes offer labour service in return to getting food

No ☐ Yes ☐

d) I sometimes sell cash crops/livestock to buy food

No ☐ Yes ☐

e) I sometimes sell my assets to get food

No ☐ Yes ☐

f) Where do you access credit for food crop farming?

i. Loans from banks ☐

ii. Women groups ☐

iii. Relatives and friends ☐

iv. Selling cash crops ☐

(g) What is your income?

Statement	**Income in Kshs**					
	Less than 500	**501-1000**	**1001-3000**	**3001-5000**	**5000-10000**	**Over 10000**
1. Daily income						
2. Weekly income						
3. Monthly income						

(c) Do you always get all kinds of food you need with your monthly income?

(i)No……. (ii) Yes…… (iii) Sometimes…… (iv) Not sure……

h**) Market and food availability:**

i) Is there ready market for your farm produce? Yes……. No……

ii) Is it easy to sell your farm produce? Yes…… No……..

APPENDIX B

KEY INFORMANT INTERVIEW SCHEDULE

Preamble

I am Pauline Wegesa, a student from Geography Department - Egerton University, pursuing Masters of Science Degree in Geography. I am involved in conducting a research study whose main purpose is to help me understand the determinants of food production at household and community level in Kuria East Sub-county. It is my sincere hope and request that you will kindly provide the necessary answers to the respective questions here presented. May I take this opportunity to assure you that any information you volunteer to give will be treated with utmost confidentiality and be used for academic purposes only. Allow me to thank you most sincerely for sparing your valuable time to assist me by answering the questions.

Interview No. …… …Sub-location ……. Date……

The Key Informants:

i. Crop Officers
ii. Meteorologists

Interview Questions

1. Name …… Occupation ……

Section 1: Meteorologist (To provide daily rainfall data for the period (2010-2014)

2. Kindly explain the rainfall pattern in Kuria East Sub-county for the last 5 years in terms of rainfall onset, cessation and amount.

Section 2: Crop Officers

3. Please give an overview of the annual food crop production in Kuria East Sub-county from the year 2010 to 2014.

……

……

……

……

……

4. Explain the effects of rainfall variability on crop production in Kuria East Sub-county for the last 5 years.

   ……

   ……

   ……

   ……

5. What are the best strategies that can be implemented in order to enable smallholder farmers adapt the socio-economic and environmental factors affecting food production in Kuria East Sub-county?

   ……

   ……

   ……

   ……

   ……

6. Explain the main barriers that hinder farming households from adapting the socio-economic and environmental factors affecting food production in Kuria East Sub-county?

   ……

   ……

   ……

   ……

   ……

7. In your own opinion, how has the government, CBO's and NGO's assisted farming households in Kuria East Sub-county adapt to socio-economic and environmental factors affecting food production?

   ……

   ……

   ……

   ……

THANK YOU FOR YOUR PARTICIPATION

APPENDIX C

FIGURES OF MONTHLY RAINFALL IN MM FOR YEARS 2010- 2014

Date/Years	**2010**	**2011**	**2012**	**2013**	**2014**
Jan	108.6	101.1	6.4	68.4	63.4
Feb	106.5	44.7	70.4	60.8	63.1
Mar	217.7	141.7	143.8	291.2	179.6
April	244.6	228.4	377.6	377.6	139.2
May	375.5	235.1	238	224.9	183.6
June	254.3	94.4	254.8	105.2	70.6
July	80.3	99.1	81	104.3	169.9
Aug	178.1	266.4	172	143.6	396.9
Sep	256.0	266.4	227.3	262.8	240.6
Oct	256.9	209.2	198	151.9	205.6
Nov	109.3	312.6	322.3	218.1	163.4
Dec	229.6	22.1	220.1	125.9	112.8

Source: Kisii Metrological Station

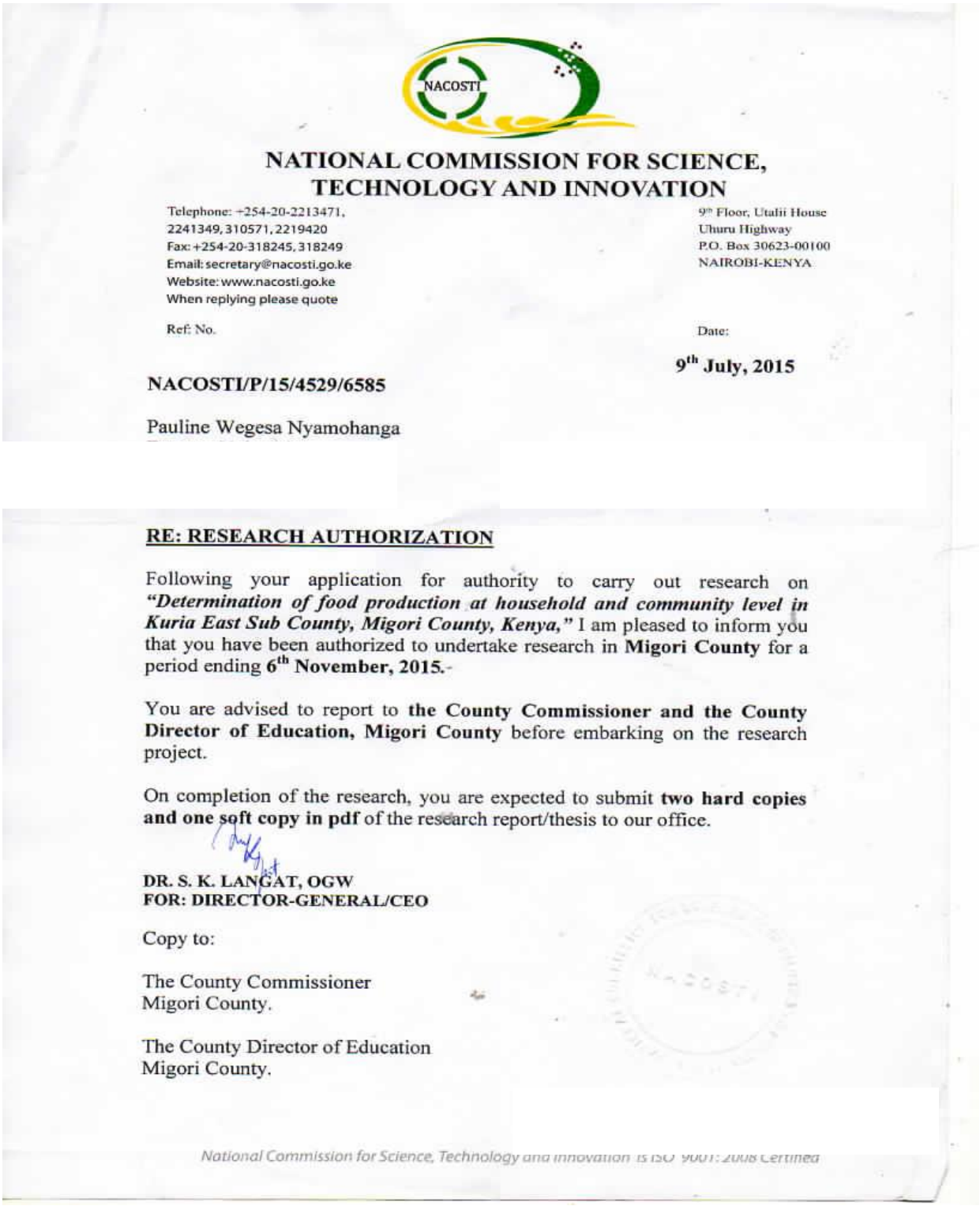
Maize Production in 90kgs/Bag for Years 2010- 2014

Years	2010	2011	2012	2013	2014
Long rain season	9,690,000	10,170,000	10,440,000	10,350,000	9,700,000
Short rain season	4,950,000	5,040,000	5,440,000	5,310,000	5,580,000

Source: DAOs validated data.

APPENDIX D

LETTER OF RESEARCH AUTHORIZATION



NACOSTI

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2213471, 2241349, 310571, 2219420
Fax: +254-20-318245, 318249
Email: secretary@nacosti.go.ke
Website: www.nacosti.go.ke
When replying please quote

9th Floor, Utalii House
Uhuru Highway
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No.

Date:

9th July, 2015

NACOSTI/P/15/4529/6585

Pauline Wegesa Nyamohanga

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Determination of food production at household and community level in Kuria East Sub County, Migori County, Kenya,"*** I am pleased to inform you that you have been authorized to undertake research in **Migori County** for a period ending **6th November, 2015.**-

You are advised to report to **the County Commissioner and the County Director of Education, Migori County** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

DR. S. K. LANGAT, OGW
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Migori County.

The County Director of Education
Migori County.

National Commission for Science, Technology and Innovation is ISO 9001: 2008 Certified

APPENDIX F

RESEARCH PERMIT

THIS IS TO CERTIFY THAT:
MS. PAULINE WEGESA NYAMOHANGA
of EGERTON UNIVERSITY, 0-20115
EGERTON,has been permitted to
conduct research in *Migori County*

on the topic: *DETERMINATION OF FOOD PRODUCTION AT HOUSEHOLD AND COMMUNITY LEVEL IN KURIA EAST SUB COUNTY, MIGORI COUNTY, KENYA*

for the period ending:
6th November,2015

Permit No : NACOSTI/P/15/4529/6585
Date Of Issue : 9th July,2015
Fee Recieved :Ksh 1,000

.....
Applicant's Signature

.....
Director General
National Commission for Science, Technology & Innovation

CONDITIONS

1. You must report to the County Commissioner and the County Education Officer of the area before embarking on your research. Failure to do that may lead to the cancellation of your permit
2. Government Officers will not be interviewed without prior appointment.
3. No questionnaire will be used unless it has been approved.
4. Excavation, filming and collection of biological specimens are subject to further permission from the relevant Goverament Ministries.
5. You are required to submit at least two(2) hard copies and one(1) soft copy of your final report.
6. The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice

REPUBLIC OF KENYA

NACOSTI

National Commission for Science, Technology and Innovation

RESEARCH CLEARANCE PERMIT

Serial No. A 5704

CONDITIONS: see back page