FACTORS INFLUENCING PRODUCTION OF STAPLE FOODS FOR SUSTAINABLE FOOD SECURITY: A CASE OF RUGURU DIVISION, MATHIRA WEST DISTRICT, KENYA

BY

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A RESEARCH PROJECT REPORT SUBMITTED IN PARTIAL FULFILLMENT FOR THE REQUIREMENTS OF THE AWARD OF A DEGREE OF MASTER OF ARTS IN PROJECT PLANNING AND MANAGEMENT OF THE UNIVERSITY OF NAIROBI.

2014

DECLARATION

This Research report is my original work and has not been submitted for award of degree in this University or any other Institution.

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DEDICATION

This Research Report is dedicated to my husband Job, my beloved sons George and Mark for their invaluable love, sacrifice and support during my study period.Further dedication goes to my dear mother Wangari for her prayers and my brother Bernard for his encouragement and support.

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ABBREVIATIONS AND ACRONYMS

AFC	Agriculture Finance corporation
ASDS	Agricultural Sector Development Strategy
BNCP	Botswana National Productivity Centre
CIAT	International Centre for Tropical Agriculture
ECPAFS	European Commission Policies and Actions for Food Security
EDF	European Development Fund
ERS	Economic Recovery Strategy
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
HCD	Human Capital Development
HIV/AIDS	Human immunodeficiency virus/acquired immunodeficiency syndrome
IFPRI	International Food Policy Research Institute
IFAD	International Fund for Agriculture Development
IFP	Irrigated Food Production
IP	Implementation Plan
KARI	Kenya Agriculture Research Institute
KAT B56	Katumani Bean 56
KFSSG	Kenya Food Security Steering Group
MDG	Millennium Development Goals
MOA	Ministry of Agriculture
NAAIAP	National Accelerated Agriculture Input Access
NCPB	National Cereals and Produce board
NGO	Non-Governmental Organizations
PHL	Post-harvest loss
PRSP	Poverty Reduction Strategy Paper
SRA	Strategy for revitalization of Agriculture
SSA	SSA
THVC	Traditional High Value Crop
UN	United Nations
WFP	World Food Organization

ABSTRACT

Food security remains an elusive goal in many parts of the world despite the global commitment to provide adequate, affordable and nutritious food. The first Millennium Development Goals is to eradicate hunger and extreme poverty around the world. Meeting food security goal has been a major challenge because of the inability of agricultural production to meet the global food demands. Food crop production is not increasing at the required rate in order to meet the population growth. Food security remains a major issue globally and regionally. Food, nutritional insecurity and poverty are wide spread in the world and are major hindrances to development. The objectives of the study were to find out how socio economic factors, agricultural management practices, proper use of inputs and training and extension influence production of staple foods in Ruguru Division Mathira West District. A descriptive survey design was used to enable the researcher reach a bigger proportion of the population as well as studying various variables. A target population of 6,650 small scale staple food producers was used. Proportional sampling techniques were used to get data from sampling frame. Representative sample sizes of 200 were picked from the target population. In addition six Agricultural Officers working with Ministry of Agriculture in the District were selected as well as two input sellers. Data was collected using selfï administered questionnaires, interview guide and observation methods. The collected data was analyzed using Statistical package for Social Sciences software. The results of the study were analyzed using descriptive and inferential statistics and the results were presented using tables. The research findings showed that 58.6 % of the respondents were women. The study findings revealed that 52.5 % of the study respondents land was self-owned although majority (26.3%)had less than 1 acre. The study findings showed that 72.2 % of the respondents had farming as their main source of income. The research findings further revealed 43.4 % of the respondents had primary education as their highest level of education. The study findings revealed that majority (85.9%) used fertilizer while 88.4 % used manure .The study findings also showed the 92.4% of the study respondents indicated that the cost of inputs was very expensive .The study findings revealed that 71.7 % of the respondents had been trained. The study findings and recommendations will help the Government to implement policies which can help in the revitalization of staple foods production in order to improve food security both at national and house hold levels. Despite the low education qualifications of the farmers producing staple foods , the study observed that the type of training offered to farmers , had a positive influence to the production of staple foods . Scarcity of accessible land by the small scale farmers was a major hindrance to effective food production and agricultural management practices like crop rotation, pest and disease management, farm planning and conservation agriculture. It is therefore concluded that capacity building is key to the production of staple food as long as the appropriate training is duly offered and with consistent back up. It can therefore be concluded that any small scale farmer of any education level as long as their capacity for production is enhanced through training can effectively and efficiently contribute in production of food. Farmer field days and group methods including demonstrations should continue to be promoted as vehicles of information dissemination and communication.

CHAPTER ONE
INTRODUCTION

1.1 Background of the Study

Food security remains an elusive goal in many parts of the world despite the global commitment to provide adequate, affordable and nutritious food (FAO,2009).The developed nations try to alleviate the problem food insecurity by providing food security interventions, including food aid in the form of direct food relief, food stamps, or indirectly through subsidized food production. Similar approaches are employed in developing countries but with less success due to insufficient resource base and shorter duration of intervention. The United Nations defines food security as a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2011). This basic need remains unfulfilled in many countries especially in Asia and Sub-Saharan Africa.

Given the projected increase in world population and pressure on natural resources, the problems of hunger and food insecurity have global dimensions and are likely to persist and even increase dramatically in some regions unless concerted action is taken. In the year 2000, nations in the United Nations (UN) developed an ambition to address the challenges resulting to advancing globalization which indeed resulted to formulation of Millennium Development Goals (MDGs). In the formation of the MDGs, attention has been paid to hunger and poverty as stated in MDG number -1; eradicate extreme poverty and hunger .The Rome Declaration on World Food Security asserts the commitment from governments around the world to the right of everyone to have access to safe nutritious food, consistent with the right to adequate food and the fundamental right of everyone to be free from hunger(Mazrui, Gatsi and Muvhunzi, 2012).

In order to meet the challenges of food insecurity, new and more global partnerships are needed between donors, international institutions, the governments, civil societies and private sectors, which should be trickled down to the marginalized communities through involving community in the implementation of food security interventions. Globally, more than 870million people are chronically hungry. The largest number of malnourished people lives in. Asia and the Pacific, while the population of Sub-Saharan Africa remains the largest concentrated block of hungry people globally (FAO, 2013).

In Central Europe, food and nutrition, insecurity and poverty which are very wide spread are hampering the regions development process (FAO, 2005). The European Commission Policies and Actions for Food Security (ECPAFS), over the years has been a prominent international actor in terms of food security. The main objective of the commission is to achieve the MDG, in particular the first of those, namely- eradication of hunger and extreme poverty around the world. Through the European commission, the European Development Fund (E.D.F.) as the main financial instrument has been funding many community projects for sustainable food security and also supporting local production through the provision of inputs like seeds, fertilizers, rural and agricultural development, consolidating of production capacities, infrastructures, micro-credit, occupational training for capacity building which together have contributed to successful implementation of the programmes for food security in the community and also in household levels. A household is said to be food secured ñif it can reliably gain access to food in sufficient quantity and quality for all household members to enjoy a healthy and active life.ò It is possible, however, for individuals in food-secure households to have deficient or unbalanced. Malnutrition is the underlying cause of death of more than 2.6 million children each year, a third of under-five deaths, and a third of total child deaths worldwide.

Brazil is one of the countries on track to achieve many of the UN MDGs particularly in reducing extreme poverty and malnutrition. Much of its achievement is credited to bold and innovative government policies and community aided programmes. ñZero hungerò is a national government strategy to reduce hunger and malnutrition. Some of the programmes and initiatives have been credited with reducing the incidences of hunger but some have not been successful. In Asia, food availability increased with the Green Revolution, but despite this food security, some parts of the region remain fragile, significantly affected by economic and climatic fluctuation. Implementation of the food programme funded by the local government has been threatened by cash income and land degradation caused by increasing population and climatic variation (Babu, 2010).

An evaluation of International Fund for Agricultural Development (IFAD) projects on food security by TANGO International specifically in India and Bangladesh concluded that, in order to achieve projectsô objectives, it is essential that projects retain the ability to adapt to changes in the programming context. Establishing and building of the capacity of community based institutions has proved an effective method of enhancing livelihood security

through support of community infrastructure or community empowerment projects (Tango International, 2007).

Global commitment to providing adequate, affordable and nutritious food remains high. Given the projected increase in world population and pressure on natural resources, the problems of hunger and food insecurity have global dimensions and are likely to persist and even increase dramatically in some regions unless concerted action is taken. Meeting this food security goal has been a major challenge because of the inability of agricultural production to keep up with global food demands. Crop yield growth has slowed in much of the world because of declining investments in agricultural research, irrigation, and rural infrastructure and increasing water scarcity. New challenges to food security are posed by climate change, urban development, population growth, limited diversification in agriculture, unproductive land, agriculture disease and pests and the morbidity and mortality of human immunodeficiency virus/acquired immunodeficiency syndrome(Bertini and Glickman, 2013).

Over the past 30 years, Africa has become subject to erratic weather patterns and is often plagued by prolonged droughts followed by floods. These natural shocks trigger adverse consequences, including widespread food insecurity. SSA is the second-most severely affected region for climatologically disasters among the developing regions of the world. This is because the temperatures are generally already high, and most of the regionôs inhabitants depend on rain fed agriculture for their livelihoods. Only 4% of cropland in SSA is irrigated, compared with a global level of almost 20%. It is believed that prolonged drought experienced in certain regions of the continent frustrated the expected reduction in poverty and food insecurity, despite the economic growth experienced across the continent over the last decade. The global rise in food prices further compounds these crises. People living on less than US$ 1.00 per day are unable to pay the prices they would need to buy all of the staple food they require and meat and fish consumption for the many poor Africans is a luxury (Gregoryet *al.,* 2005)

In 2004, 121 million Sub-Saharan Africans lived on less than a meager US$ 0.50 a day. Food crop production is not increasing at a rate necessary to meet population growth, currently averaging 2.4% annually across Africa. Although the share of the population living in extreme poverty in SSA declined by more than 10% to 48% between 1999 and 2008, SSA still has the highest concentration of the ultra-poor in the world. Despite the rapid economic growth rate in SSA over the past decade, there is historical evidence that this has not been converted into

poverty reduction as effectively as in other developing regions, like East Asia and the Pacific. Poverty also constrains the ability of farming households to invest in productive assets and agricultural technologies, resulting in insufficient agricultural productivity. African importers are unable to profitably bring in the food needed to make up national food deficits, simply because poverty is so great that insufficient demand is expressed through the market system. The root cause of food insecurity in developing countries is the inability of people to gain access to food due to poverty (IFPRI, 2002) International Food Policy Research Institute. Poverty is compounded by factors such as conflicts, disease epidemics and climate change, such as droughts.

Violent conflicts have thwarted all efforts to establish food and nutrition security in Central and East Africa. Violent conflicts, as well as ethnic unrest involving fights over water and grazing resources, the stealing of women and livestock and quarrels over border lines, have contributed to the displacement of people, disruption of transportation and market transactions and subsequently, lack of access to food. Sub-Saharan Africa is responsible for 88% of the global conflict death toll between 1990 and 2007, in addition to over 9 million refugees and internally displaced people.Food insecurity and malnutrition are linked to disease in a vicious cycle. Malnutrition is a direct consequence of food insecurity; however, even if a person consumes enough calories, this does not guarantee adequate intake of essential micronutrients vitamins, minerals and trace elements. Insufficient calorie consumption often goes hand-in-hand with micronutrient malnutrition and can have grave public health consequences. Nutrition security, a relatively newer concept is said to be achieved when secure access to food is coupled with a sanitary environment, adequate health services and knowledgeable care to ensure a healthy and active life for all household members. The causes of food insecurity and malnutrition in Africa are diverse, multi-factorial and interlinked. Poverty and food shortage are the main catalysts of food insecurity in the world; unfortunately, they occur in a vicious cycle (FAO, 2008)

Inadequate food consumption heightens vulnerability to infectious diseases. Insufficient access to safe water, poor sanitation work and diseases such as HIV & AIDS and malaria further perpetuate food insecurity in SSA. HIV & AIDS precipitate and exacerbate food and nutrition insecurity, but the spread of the virus is accelerated when people because of their worsening poverty are forced to adopt ever more risky food provisioning strategies.

Kenya like any other developing countries is faced with hunger and poverty and these problems are getting worse by the day. Kenyaôs long-term goal of food self-sufficiency remains unmet and with a population of more than 38 million people of which ten percentages is classified as food insecure; Kenya is the largest importer of food and agricultural products in East Africa. Kenya has been experiencing declining per capita agricultural production with total annual on-farm production of food crops lagging behind consumption. This has resulted in food deficits and the consequential food insecurity being witnessed in the country (KARI, 2011). Achieving household food security has been an elusive goal in Kenya where population has continued to increase with agricultural production not matching population growth (Hazell and Poulton, 2007).

The Kenyan government is a signatory to the Millennium Declaration made at the UN Millennium Summit in 2000, where leaders placed development at the heart of the global agenda by adopting the MDGs as pillars for sustainable development. The Kenyan government together with donors and NGOs have put in place initiatives and implementations mechanism to mitigate current food situation broadly described as programmes and policies that respond to immediate needs of the poor and food insecure (FAO, 2008). Some of the long term interventions include targeted food security programmes such as National Accelerated Agriculture Input Access Programme (N.A.A.I.A.P.); whose objective is to improve access and affordability of key inputs to small holder farmers, Orphaned Crop Programme (OCP) with an aim of diversifying sources of food through promotion of indigenous crops that are drought tolerance, Revitalization of Agriculture Infrastructure Mechanization Services with an objective of improving agricultural infrastructure and land development to Kenyan farmers, Irrigated Food Production (IFP), NjaaMarufuku Kenya (NMK), and Traditional High Value Crop (THVC) Programme with an aim of diversifying sources of food through promotion of indigenous crops that are drought tolerance.NjaaMarufuku Kenya was developed for implementing and fulfilling MDG-1 whose target is to halve the number of poor and hungry by the year 2015. The promotion of programmes that will ensure sustainable food security among the farmers in this area is derailed by climate change and drought among other challenges (IFAD, 2008).

1.2Statement of the problem

Food security remains an elusive goal in many parts of the world despite the concerted efforts of governments, non-governmental and international agencies over the past years. An estimated 925 million people around the world were undernourished in the year 2010 (FAO, 2011). All nations signatory to the Millennium Declaration of the year 2000, have a goal of reducing hunger and extreme poverty by halve by the year 2015 in fulfillment of the MDG goal number one. Vision 2030 has identified agriculture as one of the key sectors to deliver the 10 % per annum economic growth rate envisaged under the economic pillar. To achieve this there has been focus on programmes that increase productivity of crops, livestock and tree cover, introduction of policies for better use of high and medium potential land, improving market access and adding value to farm produce. But despite this there has been sever food insecurity even in high potential areas due to climate change, urban development, and population growth, limited diversification in agriculture, unproductive land, agriculture disease and pests (Ministry of Agriculture, 2010).

Meeting food security has been a major challenge because of the inability of agricultural production to keep up with food demands. Crop yield growth has slowed because climate change, urban development, population growth, limited diversification in agriculture, unproductive land, agriculture disease and pests. The annual rainfall in Mathira West District ranges from 800mm to 1200mm and is also unreliable. For the last five seasons the area has experienced total crop failure which has resulted to the District relying on food relief. Despite the crop failure the farmers in the area continue to grow the same crops staple foods though there are other alternative crops which are drought tolerant. Most farmers in the area rely on farming as their main source of income. The average land size in the study area is 1 acre which is not economical for food production; this is due to the ever increasing population which lead to land fragmentation.

1.3 Purpose of the study

The purpose of this study is to find out factors which influence production of staple foods for sustainable food security in Ruguru Division, Mathira West District. The study findings and recommendation will help the implementers and stake holders in the Ministry of Agriculture to implement programme which will revitalize food production initiatives to enable them achieve food security. The study will also help identify the strengths and weakness in the staple food

production and this information will be used to develop corrective actions by the programme implementers and the stakeholders in the production of staple foods. The study also hopes to provide base for further research on suitable varieties and technologies which can be adopted to improve the current staple food production. The study further hope to provide important lessons from the ground, to replicate or enable development practitioners to pay attentions while designing and implementing of both development and food security programmes. The study is also aimed at documenting social and economic factors that influence production of staple foods for planners and implementers so that key assumptions can be redefined to ensure achievement of food security country wide.

1.4 Research Objectives

The study was guided by the following objectives:-

1. To determine the extent to which socio economic factors influence production of staple foods in Ruguru Division, Mathira West District.
2. To establish the extent to which proper use of inputs influence production of staple foods in Ruguru Division, Mathira West District.
3. To establish the extent to which agricultural management practices influence production of staple foods in Ruguru Division, Mathira West District.
4. To establish the extent to which training and extension influence production of staple foods in Ruguru Division, Mathira West District.

1.5 Research Questions

The study intends to answer the following questions:-

1. To what extent do socio economic factors influence production of staple foods in Ruguru Division, Mathira West District?
2. To what extent does proper use of inputs influence production of staple foods in Ruguru Division, Mathira West District?
3. To what extent does agricultural management influence production of staple foods in Ruguru Division, Mathira West District?
4. To what extent does training and extension influence production of staple foods in Ruguru Division, Mathira West District?

1.6 Significance of the Study

The study endeavoured to provide information to the Ministry personnel at its different levels one various factors influencing staple foods production and develop sustainable mitigation measures. Farmers engage in agricultural production for diverse reasons including production to satisfy home needs and/ or for sale. Sale of food especially by subsistence producers is said to arise mainly from surplus production (Von Braun *et al*., 1994).

The study aimed at examining whether or not improved inputs use can trigger increased staple foods output commercialization as a means of increasing household income due to increased productivity. The study also aimed to provide evidence to policymakers, farmers and extension agents, on possible ways to increase the use of improved inputs, productivity and commercialization of staple foods production as well as other crops in Kenya. Empirical findings and recommendations in the subject hoped to offer practical importance for the stakeholders of the agriculture sector within the county and beyond. The study also hoped to provide important lessons from the ground, to replicate or enable development practitioners to pay attentions while designing and implementing of both development and food security programmes. The research study hoped to provide a base for further research on the factors that influence production of staple foods for planners and implementers so that key assumptions of the food-based projects can be redefined to ensure achievement of food security country wide.

1.7 Limitations of the study

One of the limiting factors of the study was language barrier where respondents to written questionnaire faced handicaps due to high illiteracy levels in the area. Use of a trained research assistant, conversant with the language of their best understanding helped in mitigating the challenges. Uncooperative informants were likely to be encountered due to suspicion on the real motives of the researcher. Working closely with the agricultural extension officers helped to explain the sole academic purpose of the study to the informants who were suspicious of the real motive of the research study. Weather was another limiting factor since study was planned for the month of March to April which is the onset for the long rains in the area. Time constraint was a limiting factor because the study was to be concluded within a short time and farmers were widely spread within the Division. Availability of funds was also another limiting factor to the study since it was self -sponsored. There was no assurance that the

respondents would return all the questionnaires duly completed, neither was there a guarantee that the interviewees would respond to all the questions put forward to them comprehensively.

1.8 Delimitation of the study

The study was restricted to Ruguru Division in Mathira West District and focused only on small scale staple food famers. The Division covers an area of 79.4 sq. kilometres and has a population of 19,744 persons as per 2009 census report.The Division has 2 locations namely Ruguru and Hombe.The annual rainfall in the District ranges from 800mm to 1200mm and is also unreliable. For the last five seasons the area has experienced total crop failure which has resulted to the district relying on food relief. Despite the crop failure the farmers in the area continue to grow the same crops though there are other crops which they can grow as an alternative to the staple foods. Open and closed ended questionnaires were used in data collection to allow the respondents respond using their own words and have adequate time to respond to the questions.

1.9 Basic Assumptions of the Study

It was assumed that all the farmers understood the local language (Kikuyu) and the farmers in the area were staple foods growers. It was a basic assumptionthat the respondents would be available and that they would cooperate and give correct and truthful information. It was also an assumption that the study would be completed within the scheduled time without major external influences.

1.10 Definition of Significant Terms

Allocative efficiency	This the ability of a farmer to choose and employ the inputs in production
Community food security	In this study it means that the community will produce enough quality food at all times
Common bean	In this study it is referred to as bean in some cases, and it is scientifically referred to as Phaseolus vulgaris L.
Demographic characteristic	Demographic characteristics refer to gender, age, education qualification and family size of the direct beneficiaries of the programme.
Economic efficiency	It is used to mean the ability of farmer to employ a cost minimizing combination of farm inputs and at the same time producing the maximum possible output, given the available technology.
Productivity	It is a measure of the efficiency of production computed herein as a ratio of output to the constraining resource (inputs) required to produce it i.e. it is the total output (in metric tons)per one unit of land cultivated (hectares).
Smallholders	These are farmers with a maximum of2hectares of total arable land whether entirely used for bean cultivation or not.
Social economic factors	The factors include age, gender, marital status, level of education, land tenure, economic and social status.
Staple foods	In this study it means maize and beans
Technical efficiency	It is the farmersô ability of a farm to produce the maximum possible yield using a minimum combination of farm resources and using improved varieties for production to the level where their marginal returns equal their factor prices.
Training	This is the method of acquiring skills to perform specific tasks.

1.11 Organization of the study

The study is organized into five chapters and each chapter contains specific information. Chapter one contains the introduction of the study. It gives background of the study, statement of the problem, purpose of the study, objectives of the study, research questions, significance of the study, limitations of the study, delimitations of the study, basic assumption of the study and definition of key terms. Chapter two contains the literature reviews based on the objectives of the study. It also contains conceptual framework and includes the research gaps. Chapter three covers the research methodology and describes the research design, target population, sampling procedure, instruments and techniques of data collection, pre-testing, operational definition of variables, methods of data analysis and ethical considerations. Chapter four contains data analysis, presentation and interpretation. Chapter five is the final chapter and it provides a summary of the findings, discussion, conclusionsand the recommendations according to the results of the study. It is followed by the references and the appendices sections.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

The chapter contains introductionto global, regional and localfood security situation as reviewed by past researchers. The reviewed literature also focuses on factors influencing production of staple foods for sustainable food security.The global food situation is redefined by many driving forces such as population growth, availability of arable lands, water resources, climate change and food availability, accessibility and loss.The combined effect of these factors has undeniably impacted global food production and security. The concept of food insecurity is complex and goes beyond the simplistic idea of a country's inability to feed its population.

The chapter also contains conceptual frame work which shows the relationship between the independent variables and the dependent variable which is production of staple foods for sustainable food security. Also contained in this chapter is the knowledge gap from the gaps identified in the literature reviewed which if bridged will contribute to successful food production.

2.2 Global food security

With almost 870 million people: representing 12.5 % of the global population, or one in eight people being chronically undernourished in 2010ï 12, the number of hungry people in the world remains unacceptably high. The vast majority of these, 852 million, live in developing countries, where the prevalence of undernourishment is estimated at 14.9 % of the population. According to(FAO,WFP and IFAD, 2012), there was some progress towards achieving food security before 2007ï 08. Since then, global progress in reducing hunger has slowed and leveled off. The rate of progress in the reduction of undernourishment has been higher in Asia and the Pacific and in Latin America and the Caribbean which has had a rapid reduction from 29.6% to 10.99 %over the period 1990-2010 meaning that the region is almost on track for achieving the MDG hunger target. For developing countries, the prevalence of undernourishment has fallen from 23.2 to 14.9 % over the period 1990ï 2010 which is above the MDG target of 11.6 %. These revised results imply that the Millennium Development Goal (MDG) target of halving the prevalence of undernourishment in the world by 2015 will not be achieved unless appropriate actions are taken to reverse the slowdown since 2007-08 (UNDP, 2009).

FAOôs State of Food Insecurity report (2002) refers to four elements of food security: food availability, food accessibility, food utilization and food system stability. Availability focuses on food production whereas accessibility focuses on the ability of people to obtain food, either through production, purchase or transfers. Food utilization focuses on the nutritional value of food, the interaction with physiological condition and food safety. Food system stability focuses on stability of supply and access, as well as the ability to respond to food emergencies. Global food security is advanced when the world empowers smallholder farmers in Sub-Saharan Africa and South Asia to maximize their agricultural potential. New research suggests that helping smallholder farmers in poor nations become self-sufficient is also one of the most effective types of foreign aid for promoting peace (FAO, 2008).

2.3 Factors influencing food production

There are many factors that influence food production. The post-war ósecond agricultural revolutionô in developed countries, and the ógreen revolutionô in developing nations in the mid-1960s transformed agricultural practices and raised crop yields dramatically, but the effect is leveling off and will not meet projected demand. There is a strong link between the state of the environment and food production, apart from the natural environment being the entire platform upon which all life is based. For crops, the state of the environment directly influences soil nutrient availability, water (ground and surface water for irrigation), climate and weather (rainfall and growth season), availability of insects for pollination, and not the least, the abundance and effects of certain pests, such as pathogens, insects and weeds, underdeveloped infrastructure means that losses increase further during transport and storage which have major impact on crops worldwide, particularly in Africa (FAO,2011)

Demand for food production due to increased population lead to demand in agricultural inputs which makes expensive for most farmers to afford thus leading to low production which further leads to food insecurity. Due to low production the demand for maize and beans exceed the supply leading to high prices. Sustainable agriculture theory involves the practice of farming using principles of ecology. Sustainable agriculture focuses on the ability of providing food on the long-term. Sustainability affects overall production, which must increase to meet the increasing food and fiber requirements as the world's human population expands to a projected 9.3 billion people by 2050 (Altieri,1995)

2.4 Food security in Africa

Most countries in Africa are facing an imminent food crisis. Whereas at independence most of these economies were self-sufficient in food production, the combination of recurrent oil crises of the 1970s, increasingly adverse weather, poor macroeconomic and sectoral performance in the 1980s and 1990s, and declining public investment in infrastructure undermined the capacity of these economies to supply sufficient food from domestic sources. Increasing food productivity is vital for enhancing future food security, peace and health. With an expected doubling of Africaôs current population to about 1.3 billion by 2020, addressing the continentôs food crisis will require great wisdom and vision. Most of the extreme poor depend on agriculture and related activities for a significant part of their livelihoods. Agricultural growth involving smallholders, especially women, will be most effective in reducing extreme poverty and hunger when it increases returns to labour and generates employment for the poor. Food insecurity has generally emerged as one of the greatest challenges facing the world community today particularly in developing countries where the population rate is growing at a faster rate than the food production per capita. Africa has the potential to feed itself if governments can focus on innovative strategies by Africans themselves towards achieving sustainable food security(Bremner, 2012).

Food accessibility for many people in the developing countries remains closely tied to local food production (FAO, 2008 and Bruinsma, 2009). The World Development Report 2008 stresses the importance of agriculture-led growth to increase incomes and reduce poverty and food insecurity in the least developed and developing countries. Countries with large food insecure populations are often also those whose agricultural systems are highly vulnerable to climate shocks now, particularly in sub-Saharan Africa and South and Southeast Asia Given the close link between local production and food insecurity, investments in the agricultural sector that increase food availability and strengthen the resilience of the food production system will have immediate positive impacts on all elements of food security in food insecure regions (Bruinsma, 2009).

However, since most African households are engaged in agriculture, the alleviation of poverty, hunger and malnutrition will be expedited through improved agricultural productivity caused by greater investment in economic growth that provides demand for rural nonfarm products and greater technical change (Byerlee and Eicher, 1997).

Among the largest maize producers in Eastern and Southern Africa, maize occupies 75% or more of cereal area only in Kenya, Malawi, Zambia and Zimbabwe. The largest maize producers in

Western Africa are Nigeria and Ghana, though the average Percentage age of maize used for human consumption is considerably lower there than in most of eastern and southern Africa. Seventy-five percentage of the projected growth in crop production in developing countries comes from yield growth and 16 %from increases in cropping intensity. Arable land expansion is found to be an important source of growth in Sub-Saharan African and Latin America. These results highlight the potential tensions that may be created between the need to increase food production and the possible transition towards sustainable, low emission agriculture strategies if viable opportunities are not developed to enable meeting both goals. While there are many factors, three are particularly important: potential impacts of climate change on agricultural production, the effects of environmental degradation, and the potential effects of future biofuel development. Climate change can impact agricultural production and supply response via changes in temperature and precipitation that in turn affects which crops can be grown and when, as well as potential yields(FAO,2011).

2.5 Food security in Kenya

The agricultural sector is the mainstay of the Kenyaôs economy. The sector directly contributes 24% of the Gross Domestic Product (GDP) and 27% of GDP indirectly through linkages with manufacturing, distribution and other service related sectors. Approximately 45% of government revenue is derived from agriculture and the sector contributes over 75% of industrial raw materials and more than 50% of the export earnings. The sector is the largest employer in the economy, accounting for 60 per cent of the total employment. Over 80% of the population, especially living in rural areas derives their livelihoods mainly from agricultural related activities. Due to these reasons the Government of Kenya has continued to give agriculture a high priority as an important tool for promoting national development(Government of Kenya, 2010).In 2008, the Gok launched Kenya Vision 2030 as the new long-term development blueprint for the country whose focus is to create a ñGlobally competitive and prosperous country with a high quality of life by 2030ò. The Vision is anchored on the economic, social, and political pillars and will be supported on the foundations of macroeconomic stability; continuity in governance reforms; enhanced equity and wealth creation opportunities for the poor; infrastructure; energy; science, technology and innovation; land reform; human resources development; security; and public sector reforms. Given the central role the agricultural sector

plays in the economy, the Government is in the process of finalizing the development of the Agricultural Sector Development Strategy (GOK, 2005).

The overall aim of this strategy is to strategically make the agricultural sector a key driver for achieving the 10 per cent annual economic growth rate expected under the economic pillar of the Vision 2030. Starting from 2008, the country has been facing severe food insecurity problems. These are depicted by a high proportion of the population having no access to food in the right amounts and quality. Official estimates indicate over 10 million people are food insecure with majority of them living on food relief. Households are also incurring huge food bills due to the high food prices. Maize being staple food due to the food preferences is in short supply and most households have limited choices of other food stuffs (Maxwell *et al*, 1998)

The current food insecurity problems are attributed to several factors, including the frequent droughts in most parts of the country, high costs of domestic food production due to high costs of inputs especially fertilizer, displacement of a large number of farmers in the high potential agricultural areas following the post-election violence which occurred in early 2008, high global food prices and low purchasing power for large proportion of the population due to high level of poverty. The average per capita consumption of maize as food is over 94 kilogram per year in Kenya, over 100 kilo gram per year in Malawi, Zambia, and Zimbabwe, and a mere fraction of that level in Ghana and Nigeria. Kenya is no exception in many regards; it has a predominant agrarian economy. Domestic maize demand outstrips domestic production in six out of ten years, leading to increasing reliance on imports to bridge the gap. This is in spite of a tremendous maize production potential exhibited between 1964-75, fuelled by the introduction of maize hybrids and related technologies, often dubbed ñKenya's Green Revolutionò (Karanja ,1996). That Kenya must increase its farm productivity and income is no longer debatable but is a great necessity. Over 85% of the population derives its livelihood from agriculture, most of who engage in maize production. With maize occupying such a central position in Kenyans 'diets and farm production activities, it is imperative that ways and means of improving maize productivity is sought. Evidence from recent years indicates that average maize yields and area have stagnated at below 2 tons per hectare and about 1.5 million hectares, respectively. Kenya has been feted as one of the best agricultural hubs in Africa, according to a research done by Kenya Food Security Steering Group (KFSSG) the country is food deficit as it imports over 20 per cent of her national food requirement annually (Olielo, 2013). The same research found out that the number of

people requiring emergency food assistance in Kenya was 3.8 million and 3.5 million in 2011. According to FAO(2009)the main factors that influence poverty and food insecurity at national, community or individual levels are land and water quality, political structures, government policies and services, exchange rates, fuel, farm equipment and inputs, agricultural production, research, development and processing, employment, culture, income, storage facilities, money and credit, transport, resource management, advertising, water and sanitation, healthcare, prepared food, and family food distribution and education.

2.6 Overview of Maize production in Kenya

Maize is the most important staple food crops in Kenya. It is estimated to contribute more than 25% of agricultural employment and 20% of total agricultural production (Government of Kenya, 2001).Despite the key role maize plays in food security and income generation in its productivity has not been adequate especially in the past four decades during which stagnation/decline in maize yield led to frequent food security problems. Ariga*et al.,* (2006) have attributed maize yield decline to four main reasons: (i) declining soil fertility and
(ii) increase in world fertilizer prices (Xu*et al*., 2006). The situation has been exacerbated by maize price fluctuation and occasional importation of cheap maize grains.

Maize is grown in almost all agro-ecological zones that allow the maize to grow irrespective of limiting temperature and rainfall environments in two out of every three farms. Bruinsma (2009) notes that land suitability for specific crops is more realistic than developing an overall suitability index due to these problems. In addition, potential changes in land quality (e.g. either rehabilitation of degraded lands or increases in degradation on existing lands), water scarcity, climate change impacts and biofuel expansion, which could affect yield growth and cropping intensity, are not explicitly included. Levels of maize production results from intricate interactions among the availability of water and nutrients, competition of weeds, occurrence of pests and diseases and actual management practices. There is limited scope for expanding cultivated land under maize production since unused land is diminishing or is of marginal quality or just unsuitable for maize production (Muchena*et al*., 1988).

In the past two decades, the country has shifted from being a net food exporter to a persistent net importer due to policy and demographic factors mentioned above, Domestic maize demand outstrips domestic production in six out of ten years, leading to increasing reliance on imports to

bridge the gap. Research has shown that average maize yields and area have stagnated at below 2 tons per hectare and about 1.5 million hectares. Given the limited arable land area and low irrigation development capacity, there is no doubt that Kenya will have to rely on other sources of food to overcome the problem of food insecurity (Karanja, Jayne and Strasberg, 2010).Maize is Kenyaôs principal crop and is wholly dependent on rainfall, while only about 17% of the country is suitable for rainfed crop production. Despite the great efforts made to increase maize production, the demand has occasionally outstripped the supply, requiring importation of large quantities of maize grain (Nyoro, 1994). Producing high maize yields on existing cultivated land is the surest way of generating the extra-required maize because there is limited scope for expanding cultivated land Traditional farming practices are no longer capable of meeting Kenyaôs maize production requirements; consequently, widespread application of scientific methods is essential. Maize production in Kenya is a highly relevant activity due to its importance as it is a dominant food crop (Karanja, Jayne and Strasberg, 2010). It is wholly produced under rainfed conditions. While almost all farmers in Kenya grow maize, it is estimated that 2% of farmers in the smallholder sector account for over 50% of the national marketed supply (Jayne, Myers, and Nyoro, 2008).

In Kenya, food insecurity has emerged due to much emphasis being placed on promotion of crops such as maize, wheat, rice and beans with little being done on traditional crops like cassava, sweet potatoes, cow peas among other crops(MOA , 2005; MOA, 2012).

2.7 Over view of beans production

Beans are known mostly for high protein value, are also high in fiber and many vitamins and minerals. When combined with small supplements of grain, such as rice or corn, beans can supply all essential amino acids, the building blocks of proteins. Beans are low in fat and sodium and contain no cholesterol or sugar. With their high carbohydrate content they digest slowly, satisfying hunger and energy needs for long periods of time. Most beans, especially black eyes, contain high levels of foliate, the B vitamin that can help prevent certain birth defects and heart diseases. Common bean is the most important food legume for direct human consumption with over 23 million hectares grown worldwide. Brazil and India are the worldôs leading producers of dry beans, accounting for about one third of world production. Latin America is the largest producer of common bean, with some 5.5 million metric tons produced annually Brazil and Mexico being the major producers. Africa is the second most important region, producing about

2.5 million metric tons, with Uganda, Kenya, Rwanda, Burundi, Tanzania, and Congo leading. China and Indonesia are the world leaders in green bean production, accounting for about half of world production. Over 200 million people in Sub-Saharan Africa depend on the crop as a primary staple, with beans contributing to diet and incomes in over 24 countries in this region alone (CIAT, 2004).However, in SSA, typical bean yields represent only 20 to 30% of the genetic potential of improved varieties due to major production risks such as insect pests, disease and drought, which ï due to climate change ï is increasing in severity and frequency in the region. Drought affects production of common beans in most of Eastern Africa, but is especially severe in the mid-altitudes of Ethiopia, Kenya, Tanzania, Malawi and Zimbabwe, as well as in Southern Africa as a whole(Gregory *et al* ., 2005).

Kenyan Agricultural Research Institute (KARI), Nairobi Common bean represents the second staple crop in the Kenyan highlands after maize. Decreasing yields and overpopulation in this area demand an intensification of food production. The Kenyan Agricultural Research Institute (KARI Embu) has been promoting improved climbing bean varieties in order to boost yields. The Central Kenyan highlands are characterized by a rapidly growing population with over 1000 people per km^2 thereby causing land fragmentation, over-cultivation and declining soil fertility which eventually leads to decreasing yields and decreasing food security (Government of Kenya, 2001; Mugwe*et al*., 2008).

There is a pressing need to intensify food production in this region one of possible way to achieve higher yields and increase food availability is the promotion of climbing bean cultivation. Beans are grown by over 95% of farmers in the region, providing over 65% of the protein and 35% of the caloric intake Common bean (Phaseolus vulgaris L.) represents the second most important staple crop in the Kenyan highlands, after maize (Kimani, P.M., 2011).

The most outstanding characteristic of climbing beans is their high yield potential: up to 4 to 5 tons/ha versus 3 tons/ha for bush beans under optimal conditions (CIAT, 2004). Inter-cropping involves growth in association with other crops (especially maize and banana), either in relay or simultaneous planting, with the other crop providing support for the climbing beans. In monoculture, climbing beans are planted with the support of wood or bamboo stakes or trellis systems. Due to its labour intensity and high yield potential, climbing beans entail a high potential in land-scarce but labour-abundant regions, such as the Kenyan highlands (Sperling*et al*., 1992; CIAT, 2004; personal communication, KARI, Embu).

2.8 Food Security in Nyeri County

Nyeri County has a population of about 693,558 according to 2009 census. It has an estimated annual maize production of about 0.9 million bags against annual requirement of 1.04 million bags. According to FAO standards food requirement for maize is 1 bag per person per year and 0.5 of a bag of beans per person per year. At glance production is lower than food requirement, causing food deficit in majority sub counties, the situation is further aggravated by post -harvest losses of about 30%. The deficit means that the household will be food insecure and have to rely on markets. Food deficit region use some of the income in purchase of food it will lead to less diversification in their diet leading to malnutrition and less funds for investment, thereby increasing poverty level. In surplus region there is reduction in saleable produce since it is the major cash/ food crop in the area low saleable produce compounded with low market price has resulted to high levels of poverty (Bremner, 2012)

There have been numerous attempts by donors, governments and technical assistance agencies over the years to reduce post-harvest losses in Kenya. Despite these efforts, losses are generally considered to remain high although, as noted, there are significant measurement difficulties. One problem is that while engineers have been successful in developing innovations in drying and storage these innovations are often not adopted by small farmers. This may be because farmers are not convinced of the benefits of using the technology. The costs may outweigh the perceived benefits and even if the benefits are significant the investment required from farmers may present them with a risk they are not prepared to take. While good on-farm drying will lead to higher milling yields or reduced mycotoxin levels this means nothing to farmers unless they receive a premium for selling dry grains to traders and mills. This is often not the case. Post-harvest loss reduction is a more efficient solution on more than one account. Instead of actually putting in more resources for producing food, we can optimize the produce by preventing the high degree of loss. By this we not only increase the food available for consumption but also optimize the wasted land, water, labour and agricultural inputs needed to produce the food (UN and FAO, 2011).

2.9 Food situation in Mathira West District

Agriculture as the main economic activity supports more than 80% of the residents in the districts. The district has a population of 60,394 people according to the 2009 census whose

distribution is shown in the Table 2.1 which also gives area by location, density and number of households.

Table 2.1Population per location Population per location

Location	Area in sq. km	Population				
		Male	Female	Total	House hold	Density
Kirimukuyu	14.5	3,553	3,822	7,375	2,070	517
Ngandu	8.6	2,415	2,752	5,167	1,365	600
Tumutumu	20.3	5,765	6,217	11,982	3,471	585
Ichuga	8.0	2,081	2,077	4,158	1,260	518
Ngorarno	10.5	1,535	1,617,	3,152	943	323
Gatungôangôa	13.4	2,169	2,273	4,442	1,232	334
Ruthagati	10.9	2,118	2,256	4,374	1,233	401
Ruguru	27.9	5,945	6,427	12,372	3,576	424
Hombe	49.7	3,725	3,647	7,372	2,149	268
Totals	**165.6**	**29,306**	**31,088**	**60,394**	**17,229**	**441**

Source: National population and housing census, 2009

Much of the agricultural products produced are from small holderôs farms, which produce both food and cash crops which are grown in the study area. The crops grown, area under cultivation and production levels are shown in Table 2.2

Table2.2Cultivation area and production for the Main Enterprises

Crop	Land under cultivation (Ha)	Production (Ton)
Coffee	1685.2	3646
Tea	17.7	44
Macadamia	82	300
Beans	800	450
Maize	1600	1800
Irish potatoes	958	1370
Cabbage	163	980

Source: District Agriculture Office,Mathira West 2013

According to the February food situation 2014a total of 30,198 persons in Mathira West District are in dire need of relief food with the estimated requirement of 18,119 bags of maize and 7,549 bags of beans for the next 6 months as shown in the Table 2.3

Table 2.3 Relief food requirement by seriously affected persons per ward.

Sub County	Village	Percentage	No. of people seriously affected	Estimate Requirement for 6 Months (90 Kg)	
				Maize	**Beans**
Mathira West	Kirimukuyu	15	9,060	5,436	2,235
	Ruguru	35	21,138	12,683	5,214
	Total	**45**	**30,198**	**18,119**	**7,549**

Source: County Director of Agriculture Nyeri, 2014.

2.10 Influence of socio economic factors on staple foodproduction.

Food insecurity in a household may be caused by a combination of factors amongst which gender issues may play a larger role. The Ministry of Agriculture strategic plan 2000-2009, recognizes the fact that women play a key role in implementation of agriculture about70% of agricultural related activities are carried out by women. A study carried out for Agricultural Sectors Investment Programme 2004 established that women were the core of the small hold agricultural in Kenya. They manage at least two fifth of the small holding and produce about 75% of the labour used in the small holding. They are largely responsible for attaining food security at the household level as they are responsible for a large part of cultivation as well as for marketing (World Bank, 2005).

2.11 Influence of proper use of input on staple food production.

In sub-Saharan Africa, greater use of mineral fertilizers is crucial to increasing food production and slowing the rate of environmental degradation .Declining soil quality on farmlands in SSA undermines prospects for ending chronic poverty and food insecurity in the region (Morris et al., 2007). Low use of fertilizer and degraded soils are the major factors limiting agriculture productivity in SSA where soil nutrient outflows far exceed inflows in most farming systems

resulting in negative nutrient balances (Sanchez et al., 1997; Vanlauwe and Giller, 2006; Vanlauwe et al., 2010). Studies of soil nutrient balance across countries in SSA show evidence of widespread nutrient mining leading to nutrient deficiencies across agro-ecological zones (Smaling et al., 1993). Enhanced soil management has been recognized as crucial to soil fertility replenishment and enhanced agricultural productivity (Mekuria*et al*., 2004). Though important in soil fertility improvement it has be reported that, farmers typically apply inorganic fertilizers at rates well below recommended levels, or not at all (Heisey*et al*., 1997; Ariga*et al*., 2006).

Recent estimates show that SSA faces what the World Bank study referred to as ñan escalating soil fertility crisis.The region lost 4.4 million tons of nitrogen, 0.5 million tons of phosphorous, and 3 million tons of potassium during the period of 1980ï 2004, costing the continent more than $ 4 billion worth of soil nutrients per year The importance of soil nutrient depletion to the overall economic development in SSA was confirmed by the June 2006 international fertilizer summit in Abuja, Nigeria, attended by representatives of forty African heads of state and governments. The summit resolved that fertilizers were strategic inputs in SSA because soil nutrient recapitalization is crucial for raising agricultural productivity in a region lagging in food production and fertilizers use (Morris et al., 2007). Today, Africa accounts for less than 1% of global fertilizer consumption. During the period of declining growth in consumption, fertilizer use on cereals, particularly maize, has become relatively more important than use on cash crops.Regional growth rates in fertilizer consumption have never been particularly high, in part because the real price of fertilizer is higher in Africa than in many other developing regions. As subsidies have been removed and exchange-rate distortions corrected over the past decade or more, relative prices paid by farmers have risen to reflect more closely the economic cost of fertilizer. Strategies for increasing fertilizer use should thus direct more attention to maize and other important staples. In higher potential areas, some fertilizer use on maize is often economically profitable even at higher relative prices of fertilizer (Muriuki and Quereshi, 2001).

Most soils in SSA are deficient in Phosphorous. Phosphorous is required not only for plant growth but also for Nitrogen fixation. Unbalanced fertilization, for example mainly with Nitrogen, may result in more weed competition, higher pest incidence and loss of quality of the product. Soil fertility decline remains the major biophysical root cause of declining per capita food availability on smallholder farms of SSA.

Recent estimates indicate that by the year 2020, the SSA annual cereal imports will rise to more than 30 million metric tonnes, as the per-capita food production continues to decline against a background of rapidly growing population estimated at 3% per annum. This failure to match food supply to demand is mainly attributed to soil nutrient depletion following intensification of land use without proper land management practices and inadequate external inputs (Sanchez and Jama, 2002).

Average annual net mining from the soils in western Kenya was 42 kg ha-1of nitrogen (N), 3 kg ha-1of phosphorous (P) and 29 kg ha-1of potassium(K) (Smaling et al., 1993). As a result, improving on farm soil fertility management is recognized as a major factor in reversing the declining trends in per capita food production and land degradation .Reversing these trends through investments in soil fertility is crucial to agricultural productivity and poverty (Place et al., 2003).In Kenya, most farms fail to make sufficient soil fertility replenishment investments, resulting in declining soil fertility, low returns to agricultural investment, decreased food security and high food prices.In the central Kenya highlands, which has high population densities exceeding 1000 people km 2, farms are characterized by widespread failure to make sufficient soil fertility replenishment investments, resulting in declining soil fertility, low returns to agricultural investment, decreased food security and general high food prices consequently threatening food security in this region (Odera*et al*. ,2000).

Fertilizers should be applied in sufficient quantities and in balanced proportions. The efficiency of fertilizer use will be high where the organic matter content of the soil is also high. In very poor or depleted soils, crops use fertilizer applications inefficiently. When soil organic matter levels are restored, fertilizer can help maintain the revolving fund of nutrients in the soil by increasing crop yields and, consequently, the amount of residues returned to the soil (Muriuki and Quereshi, 2001).

2.12 Influence good agricultural practices on staple food production.

Increasing maize production in Kenya can be approached both at farm and national levels. At the farm level, a number of important measures are necessary: execution of early and better land preparation, timely planting, planting of the most appropriate maize varieties, proper fertilization, efficient weeding and improved control of pests and diseases while family labour should be used effectively to carry out weeding operations. At the national level, several

interventions are essential: enhancing the productivity of fragile, marginal land ecosystems through improving the existing maize varieties to facilitate the expansion of maize production in marginal land areas, breeding germplasm varieties and are acid-tolerant and utilize phosphorus more efficiently, devising techniques to improve rainwater utilization and developing effective residue management practices (Borros and Adami, 2006).

The formulation of a strategy to pursue sustainable maize production in Kenya is indispensable mainly because of the scarcity of good agricultural land and rapid population growth. The farming community must know the potential of the land under cultivation and the essential crop husbandry measures necessary to achieve the maximum possible maize yields without compromising the landôs productive sustainability (Sanchez and Leaky, 1997).

Conservation agriculture often reduces evaporation from the soil, especially in drier environments. The combined water loss through runoff and evaporation often leaves less than half of the rainfall or irrigated water available for crops, the adoption of these technologies can increase crop yields and food production. Other technologies are more explicitly related to water management: Foe example water conservation and harvesting, and efficient irrigation can effectively increase the soil carbon pool (Gregory et al., 2005).

Diversified cropping and mixed crop-livestock systems enhance biological control of pests and diseases through species interactions. Application of animal manure, slurry or other carbon-rich wastes, such as coffee-berry pulp, improves the organic matter content of the soil. Animal manure is usually rich in Nitrogen, so Nitrogen immobilization is minimal.The use of fallow land to allow restoration of soil fertility is no longer a viable option in Central Kenya region, due to land scarcity caused by the decliningaverage land holding per household occasioned by rapid population growth. The current population exerts pressure on land to meet household basic needs such as food, employment and income.Farmers struggle to maintain production levels by increasing cropping intensity, intercropping and multiple cropping which further cause soil mining. Attaining improved food security and livelihoods of farmers through increased agriculturalproductivity will remain an illusion if soil mining and land degradation remain unchecked (Freeman and Omiti, 2003).

Repetitive tillage degrades the soil structure and its potential to hold moisture, reduces the amount of organic matter in the soil, breaks up aggregates, and reduces the population of soil fauna such as earthworms that contribute to nutrient cycling and soil structure.

Avoiding mechanical soil disturbance implies growing crops without mechanical seedbed preparation or soil disturbance since the harvest of the previous crop (FAO, 2008).

Although anticipated benefits of modern technologies suggest a level of food production that will sustain the global population, both political will and sufficient investments in modern agriculture are needed to alleviate the food crisis in developing countries. In this globalized era of the 21st century, many determinants of food security are trans-boundary and require multilateral agreements and actions for an effective solution. Food security and hunger alleviation on a global scale are within reach provided that technological innovations are accepted and implemented at all levels (FAO, 2010).

2.13Influence of training and extension on staple food production

The extension service plays a key role in disseminating knowledge, technologies and agricultural information, and in linking farmers with other actors in the economy. The extension service is one of the critical change agents required in transforming subsistence farming to a modern and commercial agriculture to promote household food security, improve income and reduce poverty(Mwangi J. , 1998).

Several public training institutions offer services to the agricultural sector. These include universities, middle-level colleges and institutes, and farmer and pastoral training centres. These institutions provide specialized training to clients and act as demonstration centres for improved technologies. The Agricultural Information Resource Centre and other resource centres, agricultural shows, field days, and open forums have been important sources of agricultural knowledge, information and technology. Extension workers focus on imparting key messages to farmers on each visit, with the complexity of these messages being increased in subsequent visits (Borros and Adami, 2006).

According to the Agricultural Sector Development Strategy 2010 ï 2020, inadequate levels of funding for public training institutions leading to deterioration of infrastructure and facilities for training and technology demonstration; limited capacity to train in emerging areas such as indigenous animals and plants husbandry, and organic farming; advanced biotechnology; the slow pace of commercializing services offered by training institutions; and failure to respond to market demands for specialized courses (Government of Kenya, 2010).

2.14 Theoretical frame work

This section examines the underlying theories supporting food production for food security. Theory of supply and demand is considered one of the fundamental principles governing an economy. It is described as the state where as supply increases the price will tend to drop or vice versa, and as demand increases the price will tend to increase or vice versa. Basically this is a principle that most people intuitively grasp regarding the relationship of goods and services against the demand for those goods and services. In Agriculture food production is controlled by the demand of a particular food item. When the demand is low the prices of that commodity is reduced whereas the price will increase with reduced supply. Demand for food production due to increased population lead to demand in agricultural inputs which makes expensive for most farmers to afford thus leading to low production which further leads to food insecurity. Due to low production the demand for maize and beans exceed the supply leading to high prices.

Sustainable agriculture theory involves the practice of farming using principles of ecology. Sustainable agriculture focuses on the ability of providing food on the long-term. As such, besides artificial fertilizers and pesticidesit also does not allow the use of agricultural machines running on non-renewable resources. Besides this, it focuses on finding the most energy-efficient and cost-effective method of using agricultural machines and non-renewable natural resources. For this reason it also implements natural biological cycles and controls where possible. Sustainability affects overall production, which must increase to meet the increasing food and fiber requirements as the world's human population expands to a projected 9.3 billion people by 2050 (Altieri,1995).

2.15 Conceptual frame work

The conceptual framework shown in Figure 1 indicates the relationship between the independent variables and the dependent variable which is production of staple foods for sustainable food security. The relationship between the independent variables is also affected by the moderating factors such as government policies and intervening factors such culture of the community and the weather condition. The independent variables are grouped together on the left side of the figure.

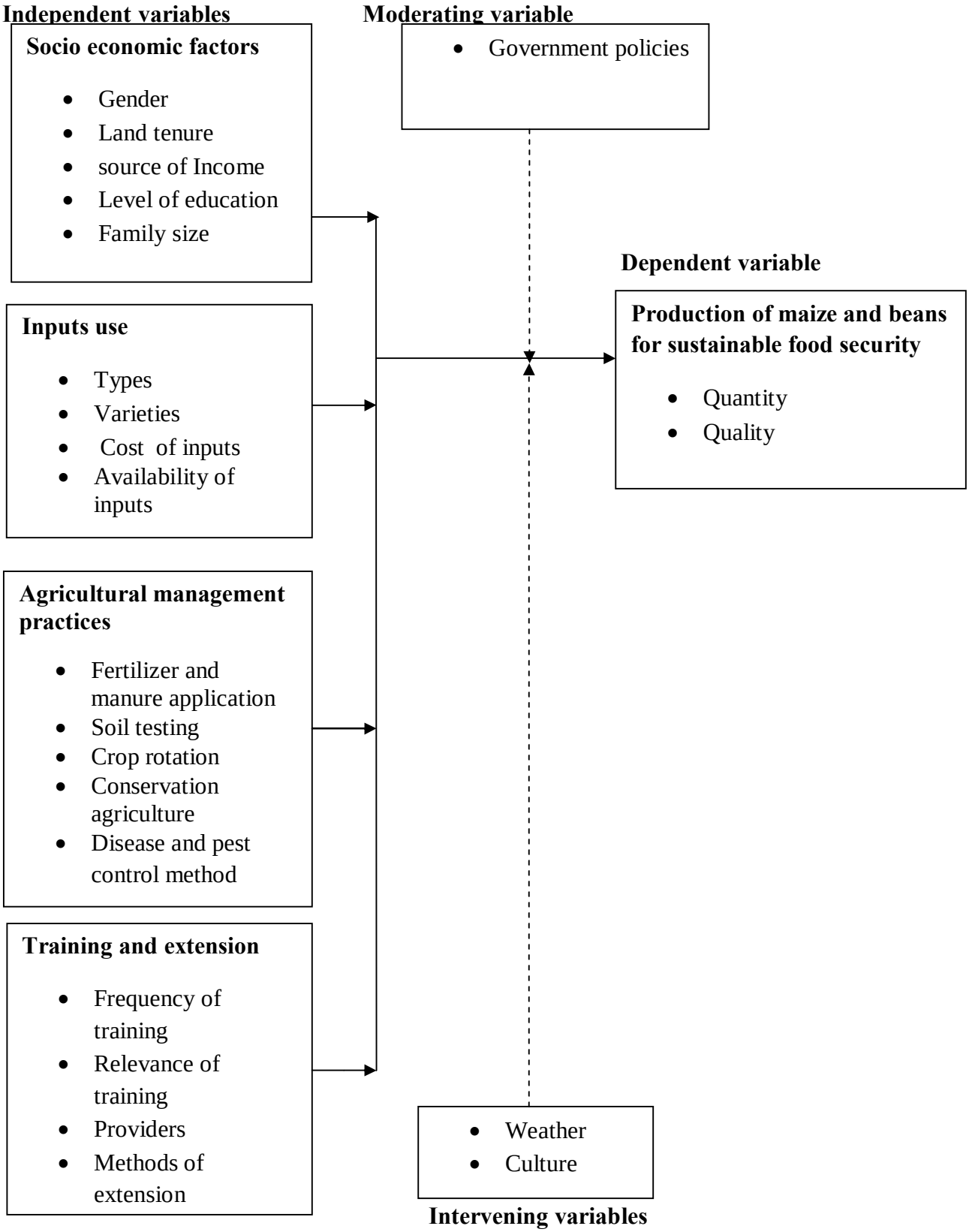

Figure 1: Conceptual Framework

2.16 Research Gap

The factors influencing production of staple foods will be studied since there is limited information on the area in the County. The main purpose of reviewing related literature was to examine how other factors influence staple foods production. Although an overwhelming amount of research has been carried out on food security issues, much attention has been on evaluation of food security interventions and their nutritional benefits and also on factors influencing their sustainability. Most of the research done on projects implementation have focused on general organizational factors which influence their implementation. The study will therefore focus on the factors influencing production of staple foods for sustainable food security, which has not been addressed by other scholars in the County.

A conceptual framework will be used to demonstrate the relationship between variables.

Most studies reviewed show the importance of integrating women in development processes to ensure sustainability. The research will cover research gapson gender and food security projects implementation and also determine the extent to which these gaps have affected achievement of food production and security. The study will contribute and promote food production and security in Ruguru Division of Mathira West District.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter provides an overview of the research methodology which was used in the study. It gives a description of the research design used, the target population studied, the sample size and sampling procedure applied, data collection methods and instruments used. Validity and reliability of the instruments used are also given in this chapter together with data analysis.

3.2 Research Design

The study employed a descriptive survey design which is under quantitative approach. The descriptive research allowed the researcher reach more respondent as well as enabling the research study various variables.The primary data was collected using self-administered questionnaires while the secondary data was collected from studying government sources like reports. According to Best and James, (2004) a survey is a means of gathering information about the characteristics, actions or opinions of a group of people, referred to as population.

It assisted in describing data and characteristics about population and phenomenon that will be studied. The descriptive survey design helps answer the questions like who, what, where and how on describing the phenomenon on study. The reasons for choosing this design is that it is the most appropriate in collecting data about the characteristics of a large population in terms of being cost effective and within the constraints of the available time and the questionnaire is employed as the main tool for data collection. Another advantage is the fact that it allows a large coverage of the population and its findings can be generalized as the total population

3.3 Target Population

Target population is that population which the researcher wants to generalize the results of the study. Mugenda and Mugenda (2003) define target population as the entire group a researcher is interested in or the group which the conclusions are drawn. The target population was small scale farmers producing staple foods in Ruguru Division. The division has two locations namely Ruguru and Hombe. Target populations of 6,650 households units wereused as shown in Table 3.1.

A total sample size of 200was selected as representative sample. In addition six agricultural officers working with Ministry of Agriculture and two key informant were selected the total number of the sample was 208.

Table 3.1Sampling Frame

Location	Sub location	Population	H /H	Sample size
Ruguru	6	12,372	3,650	110
Hombe	4	7,372	3,000	90
Total	**10**	**19,744**	**6,659**	**200**

Key: H/H-House Hold

Source: District Agriculture Office, Mathira West District, 2014

3.4 Sample size and sampling procedure

This section presents the method which was used to determine the study sample size from which data was collected. It also describes the sampling technique which was used in selecting respondents who were included as the subjects of the study. The sample had three strata namely agricultural officers, input sellers and small scale farmers growing staple foods in Ruguru Division. In the Agricultural Officersô stratum, the researcher interviewed the District Agriculture Officer, the District Crops Officer, the Divisional Agriculture Extension Officer and the Location Agriculture Extension Officers for the two Locations. The researcher also interviewed two sellers of the inputs in the area totaling to eight respondents who were selected by purposive sampling. According to Mugenda and Mugenda, (2003) non probability purposive sampling method is adopted where a group has the required information with respect to the objectives of the study and offer in depth information about the study.

3.4.1 Sample size

A sample size is a sub-set of the total population which is used to give the general views of the target population (Kothari, 2004).In the small scale maize and beans farmersô strata; the researcher used a formula adopted from Cochran,(1963) in order determine the sample size as 200 at 7% level of significance.

$$n = \frac{N}{\left[1 + N\ (e)^2\right]}$$

Where; n is sample size

N is Population size

e is Level of significance(0.07)

$$n = \frac{6,650}{\left[1 + 6,650\ x(0.07)^2\right]} = 200$$

n = 200

With a sample of 200 respondents, the proportion of sample size for every stratum was 200/6,650=0.003. The sample of 200 respondents was allocated proportionately to each of the location according to the proportionate house- holds. The respondents were selected using simple random sampling technique.

Three research instruments used in the study for data collection, included an interview guide for Agriculture Officers and key informants and a questionnaire for small scale staple food farmers. The researcher formulated the interview guides and questionnaires and administered them to the respondents whereby relevant questions concerning the study were asked. The researcher pre-visited the two locations to establish rapport with Agricultural Officers and the farmers before the actual data collection date. This made her familiar with the respondents to order alleviate any fears. Face to face interviews were conducted on farmers and Agricultural Officers in order to capture their feedback. Adequate time was accorded to each respondent in order to obtain appropriate answers to the questions. The researcher requested support for this study from the University of Nairobi management and the Agriculture Officers in Mathira West District. As soon as permission was granted, the study proceeded in the following chronology: Recruitment of three research assistants; Conducting briefs for the assistants on the study objectives, data collection process and study instrument administration, pilot testing, revision of the data collection instruments after the pilot study, reproduction of required copies for data collection upon approval by supervisors, Administration of data collection instruments to respondents, collection of duly completed research instruments, assessment of filled in questionnaires through serialization and coding for analysis, data analysis and discussion, preparation of conclusions and recommendations.

3.4.2 Sampling Technique

This is the act of selecting a suitable sample or a representative part of a population for the purpose of determining characteristic of the whole population (Frankel and Wallen, 2008). The study applied probability techniques in order to obtain the study target from the study population.

Probability technique is a sampling process in which each element of the population has an equal chance of inclusion in the sample (Ogula, 1998)

3.5 Research Instruments

Creswell (2003) indicates that research instruments are the tools used in the collection of data on the phenomenon of the study. This study used three different types of questionnaires in order to gather information from the respondents. A questionnaire according to Mugenda and Mugenda (2003) is a list of standard questions prepared to fit a certain inquiry. Questionnaires and interviews schedules were used for collecting information from small scale maize and beans farmers. The questionnaires had structured open and closed ended questions. The open ended questionnaires were used to collect qualitative data while the close ended ones were used to get quantitative data. The questionnaires were divided into seven sections. The first section of the questionnaires sought to get the personal information about the respondents and geographical area, the second section got information on demographic factors ,the third section got information on income levels of farmers , the fourth section got information on access to land ,the fifth section got information on use of inputs , the sixth section got information on good agricultural practices while the last section got information on extension and training of the farmers. The variables in the questionnaires were developed from the themes in the literature review section and research objectives. The researcher collected the questionnaires after two weeks from date of issue in order to give enough time to the respondents to fill them. Interviews were conducted on six Officers from Ministry of Agriculture as well two sellers of inputs in the area.

3.5.1 Validity of Research Instruments

According to Frankel and Wallen (2000) validity is the appropriateness, correctness, and meaningfulness of the specific inferences which are selected on research results.

This research study concerned itself with content validity. Content validity according to Kothari (2004) is the extent to which a measuring instrument provides adequate coverage of the topic under study. Content validity ensures that the instruments will cover the subject matter of the study as intended by the researcher. This type of validity measure the degree to which data collected using a particular instrument represent a specific domain of indicators or content of a particular concept (Mugenda and Mugenda, 2003).

An expert in the field of agriculture was given the instruments in order to assess the degree to which the instruments can measure and determine the content of a particular concept.

3.6 Reliability of the Research Instruments

According to Leedy (2000) consistency with which the measuring instrument performs, such that apart from delivering accurate results, the measuring instrument should deliver similar results consistently after repeated trials.Reliability of the instruments was measured through pilot testing.It involved pre-testing of the instruments to determine their validity and reliability. Pilot-testing of the instruments was carried out using a different but a similar group of farmers from Kirimukuyu Division and then necessary adjustments were made. The aim of the pilot testing was to test whether the design of questions is logical, if questions were clear and easily understood and whether the stated responses was exhaustive and how long it took to complete the questionnaire. The pilot testing also allowed the researcher to check on whether the variables collected could were processed and analyzed easily. The pilot testing was carried out on a sample consisting of 10% of the respondents. Questions found to be interpreted differently during the pre-testing were rephrased so that they had same meaning to all respondents. Views given by the respondents during pre-testing were analyzed and used to improve the questionnaires before actual collection of data.Results from the pilot study were correlated with the results of the researchstudy were correlated and had a coefficient of reliability of 0.96which is accepted according to Mugenda and Mugenda (2003).

3.7 Data Collection Procedure

The researcher collected both primary and secondary data for the purpose of making conclusion and recommendations. Primary data was collected using structured questionnaires, structured interview guide and observation method. The questionnaires were administered to farmers , input sellers and Agricultural Officers by research assistance to capture their feedback at a time and place convenient to the respondents. Adequate time was accorded to each respondent in order to obtain appropriate answers to the questions. The observation was carried out at the same day when the questionnaires were administered to the respondents at their house -holds. The secondary data was collected from the government offices through Government reports, journal and periodicals, newspaper and grey literature materials will also be used.

3.8 Data Analysis

This began with pre-processing of collected data through editing in order to detect errors and omissions and making of corrections where necessary .This involved a careful analysis of the completed questionnaires in order to ensure that collected data was accurate and consistent with other information gathered. The collected data was coded for efficiency in order to reduce the replies given by the respondents to a small number of classes. After the coding, the data was classified on the basis of common characteristics and attributes. The data was organized and tabulated inform of statistical tables in order to allow further analysis of the data. This facilitated the summation of items and detection of errors and omissions. The organized and well coded data was then analyzed through descriptive statistics which according to Frankel and Wallen (2008) is a technique which enables researchers to meaningfully describe data with numerical indices or in graphical form. This entailed analysis of Spearman correlation of factors and use of measures of central tendency such as the mean, frequencies and Percentage ages. The Statistical Package for Social Sciences was used in order to do statistical analysis of the data. Data was then presented using Percentage and tables.

3.9Ethical Consideration

According to Mugenda and Mugenda (2003) before the actual administration of the instruments, an explanation on the aim and the purpose of the study was explained to the respondents in the language they understood better. The researcher endeavoured to obtain an informed consent from the respondents before undertaking to collect data from the field. Informed consent was obtained by participantôs permission to participate in the study before administering the questionnaire to him or her. In order to obtain unbiased data the researcher exercised utmost caution while administering the data collection instruments to the respondents to ensure their rights and privacy were respected. High level of confidentiality on the information provided by respondents through interview or questionnaires was maintained. The researcher also ensured that respondents are interviewed at a time and place most convenient to them.

3.10 Operationalization of Variables

The operationalization of variables is shown in Table 3.2

Table 3.2Operationalization of Variables

Objective	Variables Independent	Indicators	Measurement scales	Tools of analysis	Type of statistical analysis
To investigate the extent to which socio economic factors influence production of staple foods in Ruguru Division , Mathira West District	Socioeconomic characteristics	Gender of the farmers	Nominal	Percentage Mean	Descriptive
		Land tenure	Ratio	Percentage Mean	Descriptive
		Source of Income	Ordinal	Correlation Means	Inferential Descriptive
		Education level	Ordinal	Percentage Correlation	Descriptive Inferential
		Family size of the farmers	Ratio	Percentage Mean	Descriptive
To establish the extent to which inputs use influence production of staple foods in Ruguru Division , Mathira West District	Inputs use	Fertilizer and seed types and varieties used	Ratio	Percentage Correlation	Descriptive Inferential
		Cost of inputs	Ratio	Percentage Mean	Descriptive
		Usage of inputs	Ratio	Percentage Mean	Descriptive
		Availability of inputs	Ratio	Percentage Mean	Descriptive
To establish the influence of agricultural management practices on production of staple foods in Ruguru Division, Mathira West District	Agricultural management practices	fertilizer and manure application	Ratio	Percentage Frequencies	Descriptive
		Soil testing and analysis	Ratio	Percentage Frequencies	Descriptive
		Crop rotation	Ratio	Percentage	Descriptive
		Disease and Pest control	Ratio	Percentage	Descriptive
		Conservation agriculture	Nominal	Percentage Mean	Descriptive

To establish the extent to which extension and training influence production of staple foods in Ruguru Division , Mathira West District	Extension and training	Type of training	Ratio	Percentage Mean	Descriptive
		The frequency of trainings	Ratio	Percentage Correlation	Descriptive
		Relevance of the trainings	Ordinal	Percentage	Descriptive
		Who provide	Ratio	Percentage	Descriptive
Improved food production	**Dependent** Production of maize and beans for sustainable food security	Food quality Food quantity	Ratio	Percentage Mean	Descriptive

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION ANDINTERPRETATION

4.1 Introduction

This chapter provides data analysis, presentation and interpretation of the data collected from the study in line with the study objectives.

4.2 Questionnaire Return Rate

The information obtained was on the socioeconomic characteristics of the staple food farmers that covered gender, age, marital status, education qualification , farmers access to land and income level, information on use of inputs, types, varieties, availability and cost. Agricultural management practices, Extension and training of the farmersô information were also obtained and the influence they had on the production of staple foods. The study sample was 208 subjects and included 200householdsôheads, 6 Agriculture Officers and 2 input suppliers**.**

The response rate was 99.0% which was considered adequate for the analysis and conclusions. According to Frankel and Wallen (2006) a response rate of above 95% of the respondents can adequately represent the study sample and offer adequate information for the study analysis and thus conclusions and recommendations.

4.3 Demographic Characteristics of Respondents

One of the study objectives was to examine influence of socio characteristics of the farmerson production of staple foods for food security. In order to establish influence of respondentsô socio characteristics, the study obtained the respondents responses on gender, age, land tenure ,source of income , marital status, family size and education qualification.

4.3.1 Gender of the respondents

One of the socio economic characteristics that the study investigated was gender distribution among the farmers producing staple food in order to establish the influence of gender on achievement of food security.Food insecurity in a household may be caused by a combination of factors amongst which gender issues may play a larger role. To fulfill this, the researcher asked the respondents to indicate their gender and the findings obtained are presented in Table 4.1

Table 4.1Gender of the Respondents

Gender	Frequency	Percentage
Female	116	58.6
Male	82	41.4
Total	**198**	**100**

According to the findings 116 (58.6%) of the 198 respondents were women while 82(41.4%) were men.

4.3.2 Age Distribution of the Respondents

Age is a demographic characteristic that is bound to influence production of the staple food . In order to determine the influence age has on production of the staple foods the study respondents were asked to indicate their age bracket for the study analysis. The findings obtained are presented in Table 4.2.

Table 4.2Age distribution of the respondent

Age distribution	Frequency	Percentage
20 years and below	7	3.5
21 to 30 years	14	7.1
31 to 40 years	64	32.3
41 years and above	113	57.1
Total	**198**	**100**

According to the study findings, 113 (57.1%) of the respondents were 41 years and above, 64 (32.3%) were between 31-40 years and 14 (7.1%) of the respondents were between 21 to 30 years.

4.3.3 Marital Status of the Respondent

Marital status is a demographic characteristic that is likely to have influence on production of staple foods. It was thereforeimportant for the studyto investigate whether marital status had any influence on the production of staple foods for food security. In order to establish its influence on staple food production, the study respondents were asked to state their marital status and the findings were analyzed and presented in Table 4.3

Table 4.3Marital status of the respondents

Marital status	Frequency	Percentage
Married	152	76.8
Widowed	24	12.1
Single	22	11.1
Total	**198**	**100.0**

According to the study findings, 152 (76.8%) of the respondents were married, 24 (12.1%) were widowed while 22 (11.1%) were single. The findings showed that a large number of the staple food farmers were married, followed by the widowed and finally by single families.

4.3.4Land Ownership

The land ownership of respondents was looked at as a socio economic factor that would influence production of staple foods. In order to answer the study question on influence of land ownership on production of staple foods, the study respondents were asked to indicate the status of their land ownership and a the findings were analyzed and presented in Table 4.4

Table 4.4Land Ownership

Land Ownership	Frequency	Percentage
Self-owned	104	52.5
Family owned	87	43.9
Rented	6	3.0
Given by a friend	1	0.5
Total	**198**	**100**

According to the study findings majority of respondents 104 (52.5 %) indicated self-owned while 87 (43.9%) as family ownedas their land ownershipstatus.

4.3.5 Total Land size

In order to answer the study question on influence of land size on production of staple foods, the study respondents were asked to indicate their total land size and the findings were analyzed and presented in Table 4.

Table 4.5Total Land Size

Land Size	Frequency	Percentage
0.5 acres and below	25	12.6
0.51 acres to 1 acres	52	26.3
1.1 acres to 1.5 acres	25	12.6
1.6 acres to 2.0 acres	38	19.2
2.1 acres to 3 acres	33	16.7
3.1 acres to 4.0 acres	9	4.5
4.1 acres to 5.0 acres	7	3.5
5.1 acres and above	9	4.5
Total	**198**	**100**

According to the study findings, 52 (26.3%) respondents indicated they had 0.5ï 1 acre, 38 (19.2 %) indicated they had 1.6-2.0 acres, 33 (16.7%) indicated they had 2.1-3.0 acresas their total land size.

4.3.6Total Cultivated Land

In order to answer the study question on influence of total cultivated land on production of staple foods, the study respondents were asked to indicate their total cultivated land and the findings were analyzed and presented in Table 4.6

Table 4.6Total Cultivated Land

Total Cultivated Land	Frequency	Percentage
0.5 acres and below	60	30.3
0.51 acres to 1acres	58	29.3
1.1 acres to 1.5 acres	21	10.6
1.6 acres to 2.0 acres	36	18.2
2.1 acres to 3.0 acres	16	8.1
3.1 acres to 4.0 acres	4	2.0
4.1 acres and above	3	1.5
Total	**198**	**100**

According to the study findings, 60 (30.3 %) of the respondents had less than 0.5 acre, 58 (29.3%) of the respondents had more than 0.5 ï 1 acre while 36 (18.2 %) had more than 1.5 acre to 2 acres as their total cultivated land.

4.3 .7 Acreage under maize

The potential of the land under cultivation and the essential crop husbandry measures necessary to achieve the maximum possible maize yields without compromising the landôs productive sustainability andthe findings are analyzed and presented in Table 4.7

Table 4.7Acreage under Maize

Area under Maize	Frequency	Percentage
0.125 acres and below	6	3.0
0.126 acres to 0.5 acres	139	70.2
0.51 acres to 0.75 acres	10	5.1
0.76 acres to 1.0 acres	37	18.7
1.1 acres to 1.5 acres	2	1.0
1.51 acres to 2.0	3	1.5
2.1 acres and above	1	0.5
Total	**198**	**100**

According to the study findings 139 (70.2%) of the respondents indicated they had more than 0.126 to0.5 acre, 37 (18.7%) indicated they had more than 0.76 to 1 acre as their area under maize.

4.3.8Acreage under Beans

The findings on acreage under beans are shown in Table 4.8

Table 4.8Acreage under Beans

Area under Beans	Frequency	Percentage
0.125 acres and below	10	5.1
0.126 acres to 0.5 acres	146	73.7
0.51 acres to 0.75	7	3.5
0.751 acres to 1.0 acres	31	15.7
1.1 acres to 1.5 acres	2	1.0
1.51 Acres to 2. acres	2	1.0
Total	**198**	**100**

The study findings shows that 146 (73.7 %) had more than 0.126 to 0.5 acre while 31 (15.7%) had more than 0.75acre as the area under beans.

4.3.9 Adequacy of accessible Land for Food Production

In order to answer the study question on influence of land accessibility on production of staple foods, the study respondents were asked to indicate whether the accessible land was adequate and the findings are presented in Table 4.9

Table 4.9Adequacy of Accessible Land for Food Production

Adequacy of accessible landfor Food Production	Frequency	Percentage
No	128	64.6
Yes	70	35.4
Total	**198**	**100**

The findings show majority 128 (64.6 %) of the respondents indicated their accessible land was not adequate for food production.

4.3. 10Main Source of Income

In order to answer the study question on influence of respondentsô socio economic characteristics on production of staple foods, the study respondents were asked to indicate their main source of income and the findings are presented in Table 4.10

Table 4.10Main Source of Income

Main source of income	Frequency	Percentage
Farming	143	72.2
Business	21	10.6
Casual off farm jobs	21	10.6
Formal employment	13	6.6
Total	**198**	**100**

According to the study findings, 143 (72.2 %) respondents indicated farming was their main source of income.

4.3.11 Income Frequency of the respondents

In order to answer the study question on influence of respondentsô socio economic characteristics on production of staple foods, the study respondents were asked to indicate their main source of income . The findings are presented in Table4.11

Table 4.11Income Frequency of the respondents

Income frequency	Frequency	Percentage
Erratic	93	47.0
Quarterly	61	30.8
Daily	20	10.1
Monthly	20	10.1
Weekly	4	2.0
Total	**198**	**100**

According to the study findings, 93 (47.0 %) of the respondents had erratic frequency of income, 61 (30.8%) had quarterly frequency and 20 (10.1 %) had monthly frequency.

4.3.12 Respondents Education Qualifications

In order to answer the study question on influence of respondentsô socio economiccharacteristics on production of staple foods, the study respondents were asked toindicate their education levels, the results of the respondentsô responses are presented in Table 4.12

Table 4.12Education level of the Respondents

Level of education	Frequency	Percentage
Primary	86	43.4
Secondary	73	36.9
None	20	10.1
College	16	8.1
University	2	1.0
Informal	1	0.5
Total	**198**	**100**

According to the study findings, 86 (43.4%) respondents indicated primary and 73 (36.9%) indicated secondary as the highest level of education.

4.3.13 Family size of the respondents

The study question on the influence of size of family on production of staple foods was responded by asking the respondents to indicate their family size. Their responses were analyzed and are presented in the Table 4.13

Table 4.13Family Size

Family size	Frequency	Percentage
1 to 5 members	133	67.2
6 to 10 members	56	28.3
11 members and above	9	4.5
Total	**198**	**100**

The findings show that 133 (67.2%) of the respondents had a family size of at least 1 to 5 members and 56 (28.3 %) had a family of at least 6 to 10 members.

4.4.14 Correlation of socioeconomic factors

The study sought to find out the relationship of socioeconomic factors and production of staple food and the results are presented in Table 4.14

Table 4.14Correlation of socioeconomic factors

	Gender	Family Size	Education Level	Main Source Income	Land Ownership	Maize Production
Gender	1.000	-0.183	-0.167	-0.189	0.056	-0.130
Family Size	0.183	1.000	-0.033	- 0.042	-0.242	0.122
Education Level	0.167	-0.033	1.000	0.067	-0.132	0.255
Main Source Income	-0.189	-0.042	0.067	1.000	0.120	0.028
Land Ownership	0.056	-0.242	-0.132	0.120	1.000	-0.292
Maize Production	-0.130	0.122	0.255	0.028	-0.292	1.000

The findings show that the socioeconomic factors had a weak correlation with maize production.

4.4 Input use

Input use was the second variable that was examined in the study and its influence on production of staple foods for food security. Greater use of mineral fertilizers is crucial to increasing food production and slowing the rate of environmental degradation. Declining growth in consumption, fertilizer use and use of wrong type has led to low productivity due to reduced levels of soil fertility leading to poor production. The study sought to find the type of fertilizer applied during planting and top dressing and their influence on staple food production. There are many reasons to use certified seed. Itôs the starting point of a successful crop as well as an important risk management tool. Certified seed uses strictly monitored quality management systems to maximize varietal purity making sure you get the specific variety you want.

4.4.1 Type of the fertilizer Used for planting maize

The study respondents were asked to indicate the type of fertilizer used for planting maize. Their responses were analyzed and are presented in the Table 4.15

Table 4.15Fertilizer used for planting Maize

Planting maize	Frequency	Percentage
Maize Planted using DAP	87	43.9
Maize Planted using 23.23.0	52	26.3
None	59	29.8
Total	**198**	**100**

Key: CAN- Calcium Ammonium Nitrate, DAP ï diammonium Phosphate

The findings show that majority of the respondents, 87(43.9%)used (DAP) and for planting maize, 52 (26.3 %) used 23.23.0 while 59 (29.8%) used no fertilizer for planting maize.

4.4.2 Fertilizer used for top dressing maize

The study sought to find the type of fertilizer applied by the respondents during top dressing of maize. The study findings for fertilizer used for top dressing maize are presented in Table 4.16

Table 4.16Fertilizer used for top dressing maize

Top dressing maize	Frequency	Percentage
Maize Top Dressed using CAN	99	50.0
Maize Top Dressed using Urea	7	3.5
None	92	46.5
Total	**198**	**100**

The findings show that majority of the respondents, 99(50 %)used (CAN) for top dressing maize, while 92 (46.5%) used Urea.

4.4.3 Fertilizer used for planting beans

The study sought to find the type of fertilizer used for planting beans. The study findings for fertilizer used for planting beans are presented in Table 4.17

Table 4.17Planting Beans

Planting beans	Frequency	Percentage
Beans Planted using DAP	63	31.8
Beans Planted using 23.23.0	19	9.6
None	116	58.6
Total	**198**	**100**

The findings show that majority of the respondents, 63 (31.8%) used DAP for planting beans, while 116 (58.6%) used no fertilizer in planting beans

4.4.4 Awareness of Certified Maize

The findings on awareness of certified beans seeds are shown in Table 4.18

Table 4.18Awareness of Certified Maize

Awareness of certified maize	Frequency	Percentage
Yes	195	98.5
No	3	1.5
Total	**198**	**100**

According to the study finding 195 (98.5%) of the respondents indicated were aware of certified maize seeds and 3 (1.5 %) indicated not aware of certified maize seeds.

4.4.5 Awareness Certified of Beans

The findings on awareness of certified beans seeds are shown in Table 4.19

Table 4.19Awareness Certified of Beans

Awareness certified beans	Frequency	Percentage
Yes	104	52.5
No	94	47.5
Total	**198**	**100**

The findings show that 104 (52.5%) of the respondents were aware of certified beans seeds and 94 (47.5 %) of the respondent were not aware of certified bean seeds.

4.4.6 Cost of Inputs

The study sought to find out the influence of cost of inputs on production of staple foods. The respondentsô were asked to indicate the cost of fertilizer. Table 4.20 shows the findings of respondentsôresponses.

Table 4.20Cost of inputs

Cost Inputs	Frequency	Percentage
Very expensive	183	92.4
Moderately expensive	15	7.6
Total	**198**	**100**

The findings show that 183 (92.4%) of the respondents indicated the cost of inputs was very expensive.

4.4.7 Fertilizer usage by respondents

The findings on fertilizer usage by the respondents are shown in Table 4.21

Table 4.21Fertilizer usages

Do you use Fertilizer	Frequency	Percentage
Yes	170	85.9
No	28	14.1
Total	**198**	**100**

The findings show that 170 (85.9 %) of the respondents used fertilizer in their farms.

4.4.8 Source of inputs

The findings on source of fertilizer are shown in Table 4.22

Table 4.22Source of Fertilizer

Source of Fertilizer	Frequency	Percentage
Local Agro Dealer	139	64.1
Supplied from NCPB	44	20.3
Agro Dealer in Karatina	27	12.4
From Tea/Coffee Factories	7	3.2
Total	**217**	**100**

The findings show that majority of respondents 139(64.1%) sourced their fertilizer from local agro dealers retail shops and 44(20.3%) sourced their fertilizer from NCPB.

4.4.9 Sources of seeds

The findings on source of seeds are shown in Table 4.23

Table 4.23Source of Seeds

Source of Seed	Frequency	Percentage
Local Agro dealer	168	77.4
Agro dealer Karatina	47	21.7
Agro dealer Nyeri	2	0.9
Total	**217**	**100**

The findings show that 168 (77.4%) of the respondents sourced their seeds from local agro dealers and 47(21.7%) sourced their seeds from agro dealers in Karatina.

4.4.10 Maize Varieties planted by respondents

The findings on maize varieties planted are shown in Table 4.24

Table 4.24Maize Varieties

Maize Varieties	Frequency	Percentage
H520	85	26.9
H513	68	21.5
H614	49	15.5
Nduma	41	13.0
516	35	11.1
H515	27	8.5
DH04	7	2.2
Katumani	4	1.3
Total	**316**	**100**

The findings showthat 85 (26.9%) of the respondents planted H 520 maize variety and 4 (1.3%) planted Katumani maize variety.

4.4.11Beans Varieties planted by respondents

The findings on beans varieties planted are shown in Table 4.25

Table 4.25Beans Varieties

Beans Varieties	Frequency	Percentage
Rosecoco	106	36.9
Beans KATX56	67	23.3
Red Harricot	59	20.6
Beans Gpl92	53	18.5
Beans KATB9	2	0.7
Total	**287**	**100**

The findings show that 106 (36.9%) of the respondents planted Rosecoco bean variety and 67 (23.3 %) planted KAT B56 bean variety.

4.4.12 Inputs availability

The study sought to find out on the availability of inputs and the findings are shown in Table 4.26

Table 4.26Inputs availability

Input Availability	Frequency	Percentage
Sometimes	111	56.1
Always	87	43.9
Total	**198**	**100**

The findings show that 111(56.1%) of the respondents indicated the inputs were available sometimes and 87(43.9%) of the respondents indicated the inputs were always available.

4.4.13 Correlation of factors on Input use

The study sought to find out the relationship of factors on input use and production of staple food and the results are presented in Table 4.27

Table 4.27Correlation of factors on Input use

	Maize Production in 2012	Fertilizer use Maize 23.23.0	Planting Beans DAP	Maize Top Dressing with CAN	Cost of Inputs
Maize Production 2012	1.000	-0.373	-0.201	-0.416	-0.109
Fertilizer use Maize 23.23.0	-0.373	1.000	-0.083	0.203	0.094
Planting Beans using DAP	-0.201	-0.083	1.000	0.185	-0.055
Maize Top Dressing with CAN	-0.416	0.203	0.185	1.000	0.024
Cost of Inputs	-0.109	0.094	-0.055	0.024	1.000

The findings show that input use and maize production had a weak correlation.

4.5 Agricultural management practices

Agricultural management practices were the third variable that was examined in the study and its influence on production of staple foods for food security.The respondents were asked to indicate various management practices for which they were aware of, whether they were implementing the practices and the level implementation in their farms.

4.5.1Awareness of management practices

The findings on awareness of management practices are shown in Table 4.28

Table 4.28Awareness of management practices

Training Types	Frequency	Percentage
Manure Application	129	10
Fertilizer Application Rate	118	9.2
Pest Disease Control	118	9.2
Fertilizer Types	114	8.9
Post-Harvest Management	108	8.4
Enterprise Selection	103	8.0
Crop Rotation	89	7.0
Soil and water Conservation	85	6.6
Varieties Selection	84	6.5
Farm Planning	67	5.2
Record Keeping	61	4.7
Agro Forestry	55	4.3
Nutrition	53	4.1
Soil Testing	52	4.0
Marketing	50	3.9
Total	**1286**	**100**

The findings show that 129 (10%) of the respondents had knowledge on manure application, 118 (9.2%) had knowledge on fertilizer application rates and 118 (9.21%) had knowledge on pest and disease control.

4.5.2Implementation of the agricultural management practices

The study sought to know whether the respondents were implementation agricultural management practices and the findings are shown in Table 4.29

Table 4.29Implementation of the management practices

Implementing the knowledge	Frequency	Percentage
Yes	140	70.7
No	58	29.3
Total	**198**	**100**

The findings show that 140 (70.7%) of the respondent were implementing the agricultural management practices and 58(29.3%) were not implementing agricultural management practices.

4.5.3 Level of management practice

The respondentsô responses on level of management practices are shown in Table 4.30

Table 4.30Level of Management Practice

Level of Practices	Frequency	Percentage
Low	92	65.7
Moderate	48	34.3
Total	**140**	**100**

The findings show that 92 (65.7%) of the respondents were implementing at low levels.

4.5.4Fertilizer application

The study sought to find the influence of fertilizer application on production of staple foods. The respondents were asked to indicate the amount of fertilizer they applied in their farmsTable 4.31shows the respondentsôresponses.

Table 4.31Quantity of Fertilizer applied

Quantity of Fertilizer applied	Frequency	Percentage
1 to 5 kgs	22	12.9
6 to 10 kgs	34	20.0
11 to 20 kgs	37	21.8
More than 20 kgs	77	45.3
Total	**170**	**100**

The findings show that majority77 (45.3%) of the respondents applied more than 20 kgs and 37 (21.8 %) applied between 11 and 20 kgs of fertilizer in their farms.

4.5.5Manure application

The respondents were asked to indicate whether they used manure in their farms Table 4.32 shows the respondentsôresponses.

Table 4.32Manure application

Manure application	Frequency	Percentage
Yes	175	88.4
No	23	11.6
Total	**198**	**100**

The findings show that majority 175 (88.4 %) of the respondents were using manure.

4.5.6 Conservation Agriculture practices

Table 4.33shows the respondentsôresponse on conservation agriculture practices

Table 4.33Practice Conservation agriculture

Practicing conservation agriculture	Frequency	Percentage
No	103	52.0
Yes	95	48.0
Total	**198**	**100**

The findings show that103 (52.0%) of the respondents were not practicing conservation agriculture.

4.4.7 Respondents practicing irrigation

The study sought to find out whether the respondents were practicing irrigation and the findings are shown in Table 4.34

Table 4.34Irrigation Practices

Irrigation Practices	Frequency	Percentage
No	154	77.8
Yes	44	22.2
Total	**198**	**100**

The study findings show that 154 (77.8%) of respondents were not practicing irrigation.

4.5.8 Amounts harvested

The respondents were asked to indicate whether the harvest for maize and beans were enough for family consumption. The findings are shown in Table 4.35

Table 4.35Harvest Enough Maize and Beans for Family Consumption

Harvest Enough Maize and Beans	Frequency	Percentage
No	148	74.7
Yes	50	25.3
Total	**198**	**100**

The findings show that 148(74.7 %) of the respondents did not harvest enough food for their family consumption.

4.5.9. Correlation of factors of agricultural management practices

The study sought to find out the relationship of factors agricultural management practices and the results are presented in Table 4.36

Table 4.36Correlation of factors of agricultural management practices

	Beans product-ion per acre	Maize Product-ion Per Acre	Manure Application	Soil Testing	Crop Rotation	Soil and water Conser-vation	Agro Forestry
Beans Production Per Acre	1.000	0.734	0.003	0.183	0.253	0.023	0.159
Maize production Per Acre	0.734	1.000	0.023	0.115	0.141	0.094	0.164
Manure Application	0.003	0.023	1.000	0.235	0.260	0.039	0.202
Soil Testing	0.183	0.115	0.235	1.000	0.501	0.449	0.625
Crop Rotation	0.253	0.141	0.260	0.501	1.000	0.319	0.464
Soil and water Conservati-on	0.023	0.094	0.039	0.449	0.319	1.000	0.533
Agro Forestry	0.159	0.164	0.202	0.625	0.464	0.533	1.000

The findings showthat there is a strong relationship of 0.734 between beans production per acre and maize production per acre while soil testing and agroforestry had a strong relationship of 0.625 and the other factors of agricultural management practices had a weak correlation.

4.6Training and extension

Training and Extension was the fourth variable that was examined in the study and its influence on production of staple foods for food security

4.6.1 Respondents ever trained

The study sought to find whether the respondents were ever trained. The findings were analysed and a represented in Table 4.37

Table 4.37Ever Trained on Agricultural Production

Ever Been Trained	Frequency	Percentage
Yes	142	71.7
No	56	28.3
Total	**198**	**100.0**

The findings show that142 (71.7 %) of the respondents had received training on agriculture production.

4.6.2 Type of trainings offered

The respondents were asked to indicate the type of training offered and the findings are shown in Table 4.38

Table 4.38Type of training

Training Method	Frequency	Percentage
Field day	123	35.6
Group training	92	26.6
Demonstration	61	17.6
Agricultural Show	31	9.0
Farmers Tour	24	6.9
Baraza	15	4.3
Total	**346**	**100**

The findings show that 123 (35.6 %) of the respondents had been trained through field day, 92(26.6%) had been trained through group training and 31 (9.0 %) had been trained through agricultural show.

4.6 .4 Training frequency of the respondents

The respondents were asked to indicate the frequency of training offered and the findings are shown in Table 4.39

Table 4.39Training Frequency

Training Frequency	Frequency	Percentage
1 to 5 times	129	90.8
6 to 10 times	13	9.2
Total	**142**	**100.0**

The finding show that 129 (90.8 %) of the respondents were trained 1 to 5 times in one year.

4.6.5 Training relevance to respondents

The respondents were asked to indicate the relevance of the of training offered and the findings are shown in Table 4.40

Table 4.40Training Relevance to respondents

Training Relevance	Frequency	Percentage
Yes	131	92.3
No	11	7.7
Total	**142**	**100.0**

The findings show that 131 (92.3 %) of the respondents indicated the trainings were relevant to staple food production.

4.6.6 Training Usefulness

The study sought to find the usefulness of the offered trainings and the findings are shown in Table 4.41

Table 4.41Training Usefulness

Training Usefulness	Frequency	Percentage
Very useful	95	66.9
Moderately useful	38	26.8
Not useful	9	6.3
Total	**142**	**100.0**

The findings show that 95 (54.3 %) of the respondents indicated the trainings were very useful to staple food production.

4.6.7. Most Frequently Accessed Source of Information

The respondents were asked to indicate the frequency of their information source and the findings are shown in Table 4.42

Table 4.42Most Frequently Accessed Source of Information

Most frequent	Frequency	Percentage
Radio	110	57.7
Extension services	32	19.3
Follow farmers	24	13.6
Newspaper	7	7.0
Phone SMS	1	1.2
NGOs	1	1.2
Total	**175**	**100**

The findings shows that the most frequent source of information for the majority 110 (57.7 %) of the respondents was radio.

4.6.8 Most Useful Source of Information

The respondents were asked to indicate their most useful source of information and the findings are shown in Table 4.43

Table 4.43Most useful Source of Information

Most useful	Frequency	Percentage
Extension services	103	56.9
Radio	53	29.3
Follow farmers	21	11.7
NGOs	2	1.1
Newspaper	1	0.5
Phone SMS	1	0.5
Total	**181**	**100**

The findings show that the most useful source of information for majority 103 (56.9 %) of the respondents was extension services

4.6.9 Correlation of factors of training and extension

The study sought to find out the relationship of factors of training and extension and the results are presented in Table 4.44

Table 4.44Correlation of factors of training and extension

	Training Frequency	Training Relevant to maize/beans production	Field Day	Group Training	Agricultural Show	Training Usefulness in Maize and Beans production
Training Frequency	1.000	0.092	0.125	0.183	0.109	0.125
Training Relevant to maize/beans production	0.092	1.000	0.350	0.172	0.089	0.445
Field Day	0.125	0.350	1.000	0.013	0.208	0.435
Group Training	0.183	0.172	0.013	1.000	-0.074	0.187
Agricultural Show	0.109	0.089	0.208	0.074	1.000	0.054
Training Usefulness in Maize and Beans production	0.125	0.445	0.435	0.187	0.054	1.000

The findings show a strong relationship between training usefulness and relevance of 0.445 and field day and usefulness of training hag a relationship of 0.435 while the other factors had weakcorrelation.

CHAPTER FIVE
SUMMARY OF FINDINGS, DISCUSSION, CONCLUSIONS ANDRECOMMENDATIONS

5.1 Introduction

This chapter presents summary of the findings, discussion, conclusions reached and recommendations in line with the research objectives. The recommendations for improvement of production of staple foods and suggestions for further research are also given.

5.2 Summary of the findings

The study sought to investigate factors influencing production of staple foods so as to recommend alternative strategies for improvement of staple food production for sustainable food security. The study was guided by the following factors socio economic factors, proper use of inputs, agricultural management practices and training and extension and their influenceon production of staple foods in Ruguru Division, Mathira West District. The study interviewed 198 small scale staple food farmer 52.0 % were from Ruguru and 48.0% were from Hombe location. The study further interviewed 6 Agricultural Officers and 2 input sellers.

5.2.1 Influence Socioeconomic factors

The study examined gender concern andestablished that 58.6% of the staple food producers were females and 41.4 % were males.Majority (57.1 %) of the staple food producers were above 41 years, among them so elderly and vulnerable to effectively carry out the production activities andonly 7.1% of youth below 25 years were involved in the staple food production activities. Study respondents were from different family status, majority (76.8 %) of the respondents largely involved in staple food production were from married families.Majority (43.4 %) of respondents producing staple foods hadprimary as their highest leveland only 10.1% of the staple food producers interviewed had not attained any formal education. It was found that on land accessibility out of the 198 study respondents, 52.5% occupied self-owned land, 43.9 % occupied either inherited land and 3% occupied rentedland. Majority (30.3 %) of the respondents were found to cultivate a land of led than 1 acre. According to the study findings majority (64.6 %) of the respondents indicated that their accessible land was not adequate for staple food production. On the income level

of the producers of staple foods is concerned, the study revealed that majority (72.2 %) of the respondents had farming as their main source of income.

5.2.2 Influence of input use

The study on input use revealed that 85.9% of the respondents used fertilizers, further study on fertilizer revealed that 92.4 % of the users revealed the cost of the fertilizer was very expensive. On the use of fertilizer 64.7 % of the respondents used Calcium Ammonia Nitrate (CAN) fertilizer for top dressing maize and 56.9% used diammonia Phosphate (DAP) for planting maize.

Study on the inputs revealed that 98.5 % of the respondents were aware of certified maize seeds and only 52.5 % of the respondents were aware of certified bean seeds and 45.2 % of the respondents planted H520 maize variety and only 2.1 % planted Katumani variety. Concerning beans 58.2 % of the respondents planted Rose coco and only 36.8% planted KAT B56 variety.Over 80% of the respondents purchased their inputs from local agro dealers and the study revealed that 56.1% of the respondents revealed the inputs were not available at all times.

5.2.3 Influence of agricultural practices

The study established that 70.7% of the respondents were implementing the agricultural management practices with 65.7% were practicing agricultural management practices at low levels. The study also established that 45% of the respondents used more than 20 kilograms of fertilizer and 88. 5% used farmyard manure.

It was further established that 76% of the respondents had knowledge on postharvest management practices, 62% had knowledge on crop rotation, 38.8% had knowledge on agro forestry and 36.6% had knowledge on soil testing and analysis. The study revealed majority (52.0 %)of the respondents were practicing conservation agriculture. The study revealed that majority (77.8%) of respondents were not practicing irrigation but 81.8 % of the respondents were using sprinkler irrigation technology and 86.4% sourcing their irrigation water from the river. The study also revealed that majority (92.4%) of the respondents were aware of water harvesting and 91.8% were practicing roof water harvesting.Majority (74.7%) of the respondents revealed that they were not harvesting enough food for family consumption.

5.2.4 Influence of training and extension

It was established that majority(71.7 %) of the staple food producers had been trained on skills and technology necessary for the production of staple foods.

Further to this, 87.9 % of the respondents had been trained through field day and 90.8 % had been trained 1 to 5 times in one year where 92.3% of the respondents confirmed that the type of training offered to them was of great relevance and 66.9% confirmed the training was useful to the production of staple foods .Majority (57.7 %) of the respondents revealed that radio was the most frequent source of information and 56.9 % revealed that extension service was the most useful source of information.

5 .3 Discussions of the findings

This section gives discussion of the findings from the study in line with the study objectives.

5.3.1 Influence Socioeconomic factors

According to findings (58.6%) of the respondents were women while only 41.4% were men. The study agrees with a study carried out by (World Bank, 2005) for Agricultural Sectors Investment Programme which showed that women were the core of the small hold agriculture in Kenya.

The study indicates that majority (57.1%) of farmers involved in staple food production were above 41 years and were already retired from their occupation or had not been successful in life. Age distribution therefore had influence of production of staple foods since only 7.1% of the young people in their productive age were involved in staple food production. The study findings concur with conclusions made by Kabue (2011) that young people may be receptive to new ideas and innovations in agriculture but may not perceive farming as an important occupation hence lack of participation

The findings showed that majority(52.5 %) owned their land. According to the study findings, 26.3% respondents indicated had total land size of between 0.5 - 1 acre and ,30.3 % of the respondents had less than 0.5 acre as their total cultivated land which as not adequate for food production as revealed by the study.The study results agree with the study findings by Thompson (1996) which indicated that land issues, fragmentation and land tenure are major obstacles to achieving the MDG goal no.1 of eradicating hunger and poverty. The findings of the study further

correlates with the findings of the study byEliud (2009) in Vihiga District-Kenya, which indicated that agricultural productivity had been affected by scarcity of productive land since much of the available land had been fragmented into small segments which could only support horticultural crops to serve the season.

According to thefinding72.2% 0f the respondents had farming as the main occupation and source of income.Lack of capital has been identified in many studies as amajor constraint in implementation and adoption of technologies.A study in Uganda by Rutaisire*et al* (2010) found that lack of capital was one of the major factors hindering project implementers from achievingtheir intended objectives. The study further agrees with Macharia*et al.* (2007) study in Central Kenya that showed that lack of affordable credit was a major impediment to intensified use of modern farming methods and technology .

According to the study findings, 43.4% of respondents had attained primary education. The study findings are supported by study finding by Kidane (2006), which indicated that attainment of basic educational skills by the household heads could lead to awareness of the possible advantages of modernizing agriculture by means of technological input, read and understand documentation, read instructions on the fertilizer packs, and diversification of household income which in turn would enhance household food supply. Macharia*et al.,*(2010),in his study conducted in Kiambu, Kirinyaga and Maragwa Districts established that the education level of households heads was an important factor influencing what development projects people would initiated collectively, which new farming technologies would be adopted and what farming enterprises to undertake.

5.3.2 Influence of input use

Fertilizers are a critical element for staple food production, but fertilizer use in Africa averages only around eight kilograms per hectare, which is less than 10 percent of the world average (Bumb*et al*., 2011). A large body of evidence has demonstrated the substantial impact on yields and output that increased fertilizer use would have in Africa. The low rate and type fertilizer used seem to significantly contribute to soil degradation the use of mainly diammonium fertilizers which could be having soil acidifying effects could be contributing low agricultural productivity. A key determinant of fertilizer use is the price of fertilizer relative to the price of the staple output. Findings revealed majority (92.4%) respondents revealed that the cost of inputs was high and not readily available when needed. Use of wrong inputs and

inadequate rates of application results in low the yields due to low nutrient levels which in turn reduce soil fertility which require to be boosted through application of right amounts of right fertilizers as well as use of right varieties of seed. In Ethiopia, for example, use of improved hybrid maize could help quadruple productivity; and even if just half the farmers achieved the productivity associated with hybrid seeds, the domestic production would replace commercial imports (Alemu, 2010).

5.3.3 Influence of agricultural management practices

Most of the study respondents had other sources of incomes regardless of their size from the study findings, the study respondents revealed that the income they got from other sources played a great role in sustaining the production of staple foods Level of income of farmers producing staple foods was therefore concluded as a factor influencing production .The findings show 70.7 % of the respondents were implementing the agricultural management practices although 65.7% of the respondents were implementing it at low level. Scarcity of accessible land by the small scale farmers was a major hindrance to effective food production and agricultural management practices like crop rotation, pest and disease management , farm planning , conservation agriculture and others were limited by land accessible for cultivation as confirmed by the study findings by Hammond (1979), in his book has developed a contingency model of the project implementation process which includes people as a situational variable whose knowledge, skills and abilities must be considered for project success. It is also important for the project to be implemented by people with technical skills and with adequate technology to perform their tasks. A study by Shalmali (2006) on the programmeôs implementation reveals that lack of knowledge and skills have prevented people from taking full advantage of recent Government agricultural programmes .It can be interpreted that education is essential to the implementation of the programme though the level ofeducation qualification of the programme implementers does not directly influence implementation of food-based projects.

5.3.4 Influence of training and extension

Despite the low education qualifications of the farmers producing staple foods , the study observed that the type of training offered to farmers , had a positive

influence to the production of staple foods . It is therefore concluded that capacity building is key to the production of staple food as long as the appropriate training is duly offered and with consistent back up.It can therefore be concluded that any small scale farmer of any education level as long as their capacity for production is enhanced through training can effectively and efficiently contribute in production of food. However, education should be availed to all citizens since it creates self-confidence and self-esteem in individuals.Similar study done in Accra-Ghana resulted to related findings in that technical education was the most consistent fountain in providing skills and capacity which is a major determinant of food security through agricultural programmes.

The results agrees with those of Adolwa*et al*., (2010) who argues that farmer field days and group methods including demonstrations should continue to be promoted as vehicles of information dissemination and communication.

5.4 Conclusion of the Study

The following conclusions were made from the study in line with the study objectives. The study showed that most of the farmers were marginalized on gender, age and education and still suffers inequalities in the development ladder. Gender inequality is still in existence and plays a major role in placing the women in informal sectors, in limited wages employment activities it is an outstanding factor that plays a major role in food insecurity at house hold level.Land is a major resource for food production and majority of the small scale farmersôoccupied land that was self-owned which was less than 1 acre and was not adequate for food production for sustainable food security.Scarcity of accessible land by small scale farmers was a major hindrance to effective food production and implementation of agricultural management practices like crop rotation, pest and disease control.

The study also showed that education is essential to the implementation of the programme though the level ofeducation qualification of the programme implementers does not influence directly implementation of food-based projects. Any small scale farmers of any education level as long as their production capacity is enhanced through training can effectively and efficiently contribute in food production. In addition cost of inputs was shown to be major barrier to staple food

production since farmers were not able to use the right seed variety and the right fertilizer type and amounts results to low soil fertility thus poor yields.

The study indicated that agricultural management practices are key for higher production and are influenced by training as well as financial resources which enable farmers to adopt better practices as well as new farming methods. Lastly capacity building is a key factor in food production as long as appropriate training is duly offered to the farmersô Training had asignificant correlation to implantation of agricultural practices. Capacity building is therefore important in enhancing their effectiveness and efficiencyin food production.

5.5 Recommendations of the Study

The following recommendations were made in order to improve production of staple foods and also to ensure sustainable food security.

The Government should enforce land policies on change of use with high potential areas for agriculture production being set aside for food production only in order to overcome the challenge of reduced land for food production as well as uneconomical land fragmentation.

It is recommended that the subsidized fertilizer should be packaged in smaller quantities apart from the current 50 kg bag as well as availing the subsidized inputs near the farmers and on time. It is also recommended that farmers should be trained on proper use of the fertilizer, the right type, the right application rates as well as the right mode of application for better results.It is also recommended that soil testing and analysis should be done in all farms, crops and regions as possible and inorder toidentify key soil fertility constraints to improve crop yield and develop a long term soil fertility improvement strategy. A data base on soils in the whole County should be compiled. For efficiency, effective and uniform soil sampling and analysis,and all Ministry of Agriculture Extension Workers should be trained on soil sampling and analysis be provided with simple testing kits which can be used at farm level.

It is recommended that awareness creation and sensitization on the available drought resistant and early maturing varieties for maize and beans should be undertaken by the extension workers and the stakeholders in seed industry. It is also recommended that

farmers to make use of that certified beans seed and avoid recycling own seeds for better yield for beans. More drought resistant, early maturing and disease resistant varieties of beans and maize should be supplied at affordable prices to the local agro dealers within the area.It is recommended that farmers should diversify their food production to other types of crops like cassava, cowpeas among others which are drought tolerant. The community should also diversify their food preference to include foods like sweet potatoes, bananas and Irish potatoes as a source on carbohydrates to minimize over reliance on maize.

It is recommended that the extension services should be improved through retraining of existing extension workers , increasing the number of the extension service providers at farm levels .The government should also increase the facilitation of extension service so as to enable service delivery through training, demonstration , farm visit as well as group trainings amongst other training avenues so as to ensure the farmers are equipped with the right knowledge and technology for staple food production .

5.6 Suggestions for Further Study

The following areas for furtherstudy are proposed from the study.

i. It is suggested that another studyon the influenceof the inputs on staple food production for sustainable food security should be done in the County.
ii. It is also suggested that a study on influence of irrigation water on production of staple foods for sustainable food security should be done in the County.
iii. Further study on the influence of agriculture on sustainable environment management should be done in the County.
iv. A study on the influence of Maize Lethal Necrosis (MLN) disease on production of maize for food security should be conducted in the County.

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APPENDICES

Appendix 1: Letter of transmittal

Jacinta WanjikuKimani,
P.O BOX 463-00100,
Nyeri.
Phone: 0722 321 760
E-mail:wanjikim72@yahoo.com

Dear Respondent,

I am a student of the University of Nairobi Nyeri Centre pursuing a Masters of Arts Degree in Project Planning and Management. I am conducting academic research on the factors influencing production of Maize and beans in Ruguru Division in Mathira West District. This questionnaire has been prepared to obtain information on factors influencing production of maize and beans by small scale farmers.

Please note that all the information provided for this study will be treated with utmost confidentiality. Your ability to answer all the questions comprehensively and to the best of your knowledge will be highly appreciated.

Thank you for your co-operation and precious time.

Yours faithfully,

Jacinta WanjikuKimani
L50/65718/2013

Appendix 2: Questionnaires for farmers undertaking maize and beans production

Instructions

Please tick in the appropriate box and also fill in the blank spaces provided for those questions where elaborate answers are required. You are requested to complete this questionnaire as honestly and objectively as possible. Use the space at the back of this questionnaire if you need more space for your responses.

SECTION (1): Geographical location

District: ---------- Division---------- Location ----------

HH Code: ---------- Village: ----------Agro-ecological zone (AEZ): --------

SECTION (2): Demographic data

Please put a tick where appropriate.

1. What is your gender (i) Male [ ] (ii) Female [ ]

2. What is your age bracket in years?

(i) 20 and below [ ] (ii) 21 -30 [ ] (iii) 31 -40 [ ] (iv) 41 and above [ ]

3. What is your marital Status? (i) Single [ ] (ii) Married [ ] (iii) Widowed [ ]

4. What is your type of the family? (i) Female headed [ ] (ii) Male headed [ ]

(iii) Child-headed [ ] (iv) OthersSpecify.....

5. What is the size of the family? (i) 1- 5 [ ] (ii) 6- 10 [ ] (iii) 11 and above [ ]

6. What is the level of your education? (i) Primary level [ ] (ii) College level [ ]

(iii) Secondary level [ ] (iv) University level [ ] (v) Informal **[ ]** (vi) None [ ]

SECTION 3: Income level of the farmers

(Tick where appropriate)

7. What is your main occupation? (i) Farmer [ ] (ii). Business [ ]

(ii) Casual employment [ ] (iv) Formal employment [ ] (v) Other (specify)é é

8. What is your main source of income? (i) Farming [ ] (ii) Business [ ]
(iii) Formal employment [ ](iv) Casual off farm jobs [ ]
(v) Others specifyé é é é .é é é é é é é é é é é é é

9. What is the frequency of your income?
(i) Daily [ ] (ii) Weekly [ ] (iii) Monthly [ ] (iv) Quarterly [ ] (v) Erratic [ ]

10. What is your income per season in shillings, (a) from maize? (i) None [ ]
(ii) Less than 1000 [ ] (iii) 1001-5000 [ ] (iv) More than 5000 [ ]
(b) From beans? (i) None [ ] (ii) Less than 1000 [ ] (iii) 1001-5000 [ ]
(iv) More than 5000 [ ]

11. What is your income per month in shillings from other external sources other than from maize and beans production?
(i) None [ ] (ii) less than 1000 [ ] (iii) 1001-5000 [ ] (iv) More than 5000 [ ]

12. To what extent do you think other external sources of income have helped in the production of Maize and beans ?
(i) Great extent [ ] (ii) Low extent [ ] (iii) No extent [ ]

SECTION 4: Access to land

(Tick Appropriate)

13. What is the ownership of the land you cultivate?(i) Self owned [ ]
(ii) Family owned [ ] (iii) Rented (iv) Others (specify)

14. What is your total land size in acres? _____what size do you currently cultivate in acres? _____

15. Is the land accessible adequate for the food production? Yes [ ] No [ ]

16. What area is under maize?_____ acres, Beans ?_____acres.

17. How many times do you plant in one year? é é é é .

18. What was your planting area, production per acre per and sales for the last three year for maize and beans?

Year	**Area under crop in acres**	**Production per acre in bags**		**Amounts sold in bags**	
		Maize	**Beans**	**Maize**	**Beans**
2011					
2012					
2013					

19. Do you harvest enough maize and beans for your family consumption?

Yes [ ] No [ ]

20. If no how do you cope with the deficit_____

_____

21. What period in a year do you experience foodshortage? _____in months.

22. Where do you store you produce? (Tick appropriate)

Granary [ ] Containers [ ]

House [ ] Others specify [ ]

23. Do you treat your cereals and pulses during storage? (Tick appropriate)

Yes [ ] No [ ]

24. If yes what treatment methods do you use? (Tick appropriate)

Chemicals [ ] Others specify [ ]

Ash [ ]

25. Apart from maize and beans which other crops do you grow in order of importance?

Likertscale 5 - most important, **1-** least importance

Crop	**5**	**4**	**3**	**2**	**1**
Irish potatoes					
Cassava					
Bananas					
Sweet potatoes					
Others specify					

26. List in order of importance the agricultural enterprises undertaken in your farm.

Likert scale **5**- most important **1**- least importance

Enterprise	**5**	**4**	**3**	**2**	**1**
Dairy cow					
Dairy goat					
Poultry					
Piggery					
Others specify					

27. Do you practice irrigation in your farm? Yes [ ] No [ ]

28. If yes what area do you irrigate in acres? é é é é é é é é ..

29. What types of irrigation technology do you use? (Tick as appropriate)

i. Drip irrigation [ ]

ii. Sprinkler [ ]

iii. Surface [ ]

iv. Bucket [ ]

v. Others specify

30. What are your Sources of irrigation water? (Tick as appropriate)

i. Earth dams/water pans [ ]

ii. Roof catchment water [ ]

iii. River water/sea/lake [ ]

iv. Borehole water/

v .Shallow well [ ]

vi. Tap water **[**]

vii. Others specify

31. Do you know what is water harvesting? (Tick appropriate) Yes [ ] No [ ]

32. What Water harvesting technologies do you practice? (Tick as appropriate)

i. Roof catchment [ ]

ii. Water pans [ ]

iii. Road runoff harvesting [ ]

iv. Bore hole [ ]

v. Others specifyé é é é .....

33. Do you practice conservation agriculture in your farm? Yes [ ] No [ ]

SECTION 5: Input fertilizer and seeds (Tick appropriate)

34. Do you use fertilizer in your farm? Yes [ ] No [ ]

35. What type of fertilizer do you use for?

(a) Planting maize (i) DAP [ ] (ii) 23.23.0 [ ] (iii) None [ ]

(b) Top dressing Maize (i) CAN[ ] (ii) Urea [ ](iii) None[ ]

(c) Planting beans (i) DAP [ ] (ii) 23.23.0 [ ] (iii) None [ ]

36. Where do you buy your fertilizer? (i) NCPB [ ] (ii) Agro dealers in Nyeri town [ ]
(iii) Agro dealers in Karatina town [ ] (iv) Local agro dealers [ ] (v) Local retail shops[] (vi) Others specifyé é é é é é .....

37. What quantity of fertilizer do you buy in kgs? (Tick appropriate)
(i) 1- 5 [ ] (ii) 6- 10 [ ] (iii) 10 -20[ ] (iv) More than 20[ ]

38. Do you use manure in your farm? (Tick appropriate) (i) Yes [ ] (ii) No [ ]

39. If yes what type? (Tick appropriate) (i)Farm Yard Manure [ ] (ii) Compost t [ ]
(iii) Others specify é é é é é é é é é é é é é

40. How much manure do you apply per hole? Less than 100 gms [ ] 200 - 300gms [ ]
More than 300gms [ ]

41. Are you aware of certified seeds? (i) For maize? Yes [ ] N o [ ]
(ii) For beans? Yes [ ] N o [ ]

42. What varieties do you plant in your farm for? (Tick appropriate)
(a) Maize (i) H 513 [ ] (ii) H515 [ ] (iii) H520[ ] (iv) H 516 (vi) DH04[ ]
(vii)H614 [ ] (viii) Nduma[ ] (ix) Katumani [ ]
(x) Others specify é é é é é é é é é é é é é é é é é é
(b)Beans (i) Gpl 56 (Rose coco) [ ] (ii)RedHaricot(Warimu) [ ]
(iii) KAT X56 (Drought resistance) [ ] (iv) Gpl 92 (Mwitemania) [ ]
(v) KAT B (9) (Gachuma)
(vi) Others specifyé é é é é é é é é é é é é é é é é .

43. What quantity of maize seedsdo you buyin kilo grams? (Tick appropriate)
(i) 1-2[ ] (ii) 3-5 [ ] (iii) 6-10[ ] (iv) More than 10[ ]

44. What quantity of beans seeds do you buy in kilograms? (Tick appropriate)
(i) 1-5[ ] (ii) 6-10 [ ] (iii) 11-15[ ] (iv) More than 15 [ ]

45. Where do you get your seed from? (Tick appropriate)
(i).Agro dealers in Nyeri town [ ] (ii) Agro dealers in Karatina town [ ]
(iii)NCPB [ ] (iv) Local agro dealers (v) Local retail shops [ ]
(vi) Othersspecifyé é

46. Are the inputs readily available? (i) Always [ ] (ii) Sometimes [ ] (ii) Never [ ]

47. What do you think about the cost of the inputs? (Tick appropriate)
(i)Very expensive [ ] (ii) moderately expensive [ ] (iii) Cheap [ ]

SECTION 7: Training and extension (Tick appropriate)

48. Have you ever attended any training on agricultural production? Yes [ ] No [ ]

49. What type of training was it? (Allow multiple)

Field day [ ]
Demonstration [ ]
Group training [ ]
Other specify [ ]
Agricultural show [ ]
Farmers tour [ ]
Barazas [ ]

49. How many times have you been trained in duration of one year?

(i) 1-5 [ ] (ii) 6-10 [ ] (iii) 10 and above [ ]

50. In your own opinion, do you think the training offered was relevant towards in maize and beans production? (i) Yes [ ] (ii) No [ ]

51. To what extent has the training been useful to the production of maize and beans?

(i) Very useful [ ] (ii) moderately useful [ ] (iii) Not at all useful [ ]

52. Which of the following areas of agricultural practices are you aware of? (Allow multiple)

Enterprise selection [ ]
Varieties selection [ ]
Fertilizer application rates [ ]
Fertilizers Types [ ]
Manure application [ ]
Soil testing [ ]
Crop rotation [ ]
Farm planning [ ]
Pest and disease control [ ]
Soil and water conservation [ ]
Agro forestry [ ]
Human Nutrition [ ]
Post -harvest management [ ]
Marketing [ ]
Record keeping [ ]
Others specifyé é é é é é ..

53. Do you implement the above mentioned knowledge areas of management in your farm? (Tick appropriate) Yes [ ] No [ ]

56. How do you access information on maize and bean farming? How useful is each source of information?

Source	**Frequency of access to information 1 least frequent to 9 most frequent**	**Rank the usefulness of source from 1 least useful to 9 very useful**
1.Radio		
2.Extension office		
3.Fellow farmers		
4.Neighbours		
5.Group members		
6.News papers		
7. Phone SMS		
8. NGOs		
9 .Others specify		

57. In your own opinion do you think production of maize and beans is sustainable?

Yes [ ] No [ ]

58. Give two ways on how production of maize and beans can be improved

_____

_____

59. Suggest two ways on how the cost of inputs can be reduced _____

_____

Thank you for your time

.

Appendix 3: In-depth interview guide for officers of Ministry of Agriculture.

Instructions

Kindly spare your time to answer the following questions based on your experience on the maize and beans production. All information will be confidential and only used for research purpose

Code:……Area of work: District [ ] Division [ ] Location [ ] (Tick appropriate**)**

Section: Crops [ ] Agribusiness [ ] Environment [ ] Others Specify.....

Number of years worked in the area …….

1. What is the current production level of the farmers?

   (i) Maize per acre é é é é . (ii) Beans per acre é é é é é é

2. What are the optimum production levels for? (i) Maize per hectare é é é é .

   (ii) Beans per acre é é é é é é

3. To what extent have your farmers succeeded in production of maize and beans?

   (i) Very successful [ ] (ii) successful [ ] (iii) Not successful [ ]

4. If not successful, give three factors which have contributed their failure?

   é

   é

   é .....

5. Give three mitigation factors can be put in place to improve production of maize and beans é .....

   .....

   .....

6. In your own opinion do you think access to land by farmers influences production of maize and beans? (i) Yes [ ] (ii) No [ ]

7. If yes, give two land issues which can be addressed in order to ensure sustainable food securityé .....

   é .....

8. To what extent do you think the use of inputs influence production of maize and beans?

   (i) Extremely [ ] (ii) Moderately [ ] (iii) Barely [ ]

9. Give 3 suggestions on how to address the issue of inputs use by farmers.

.....

.....

.....

10. How often do you offer trainings to the farmers?

(i) Daily [ ] (ii) Weekly [ ] (iii) Monthly [ ] (iv) Annually [ ]

11. What 3 main farmers training methods do you use?.....

é é

é ....

12. From your experience which two extension methods do most farmers prefer?

.....

.....

13. What is the turn-up rate of the farmers during the training sessions and for field demonstrations? (i) High turn-up [ ] (ii) moderate turn-up [ ] (iii) low turn-up [ ]

14. Do the farmers implement the training towards production of maize and beans?

(i) Yes [ ] (ii) No [ ]

15. To what extent do the farmers implement the training in production of the maize and beans farmers? (Tick appropriate)

(i) Very successful [ ] (ii) Successful [ ] (iii) Not very successful [ ]

16. From your own assessment, do you think the income level of the beneficiaries influence production of the maize and beans? (Tick appropriate) Yes [ ] No [ ]

17. To what extent do you think level of education influence production of maize and beans?

(i) High [ ] (ii) Moderate [ ] (iii) Low[ ]

18. Give 3 agricultural practices you can advise the farmers to adopt to mitigate challenges of climate changes?

.....

é ..

é ....

19. Who are the main collaborators in extension in the area?

é ....

é é

é ....

20. In your own opinion give 3 interventions that the Government should put in place in order to address food security.

....é é é é é é é é é é ..é ....

é ..é ..é é

é é

é é

21. Which 3 major challenges do you face when offering extension services to the farmers?

....

....

....

Thank you

Appendix 4: In-depth interview guide for key informants

Instructions

Kindly spare your time to answer the following questions based on your experience in the business of input supply.

Questionnaire code é é é é é ..Area of operation é é é é é é é é é .

1. What is your gender? (i) Male [ ] (ii) Female [ ]

2. What is your age bracket in years?

(i) 20 and below [ ] (ii) 21 -30 [ ] (iii) 31 -40 [ ] (iv) 41 and above [ ]

3. How many of years have you been in the business? é é é é é é é é é é ..

4. What is the nature of business ownership? (Tick appropriate)

(i) Self [ ] (ii) Family [ ] (iii) Joint [ ] (iv) Others Specifyé é é .

5. What type of inputs do you sell? Fertilizers [ ]Seeds [ ] Insecticides [ ] Fungicides [ ]

Others specify.....

6. What main packaging units in kilograms do you stock? (Allow multiple)

(a) For maize:- (i) 2kgs [ ] (ii) 5kgs [ ] (iii) 10 kgs [ ] (iv) Over 10 kgs [ ]

(b) For beans (i) 2kgs [ ] (ii) 5kgs [ ] (iii) 10 kgs [ ] (iv) Over 10 kgs [ ]

(c) For fertilizer (i) 0-5kgs [ ] (ii) 5- 10kgs [ ] (iii) 10- 15 kgs [ ]

(iv) 15- 20kgs [ ] (v) Over 20 kgs [ ]

7. According to you what package do most farmers prefer?

(i) 0-5kgs [ ] (ii) 5- 10kgs [ ] (iii)10- 15 kgs [ ] (iv) 15- 20Kgs [ ]

(v) Over 20 kgs [ ]

8. Who are your main customers for maize seeds, beans seeds and fertilizer? (Tick Appropriate)

(i) Large scale farmers [ ] (ii) Retailers [ ] (iii) Small scale farmers [ ]

9 . Give 3 Major challenges which you face in your business

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é é
é é é é é é é é é é é é é ....

10. Suggest 2 ways in which the challenges can be solved é é é é é é é é é é é ..

é ...é é é
é ...é é é é é é .
....

11. How can you rate input use by the farmers in the area? (Tick Appropriate)

(i) Very High [ ] (ii) Moderate [ ] (iii) Low [ ] (iv) Very Low [ ]

12. In your opinion do you think the cost of inputs influence the usage by farmers?

Yes [ ] No [ ]

Thank you