THE RELATIONSHIP BETWEEN CHOICE OF FARM ENTERPRISES AND FOOD SECURITY AMONG HOUSEHOLDS LIVING ALONG KERIO VALLEY, TAMBACH WARD, ELGEYO-MARAKWET COUNTY, KENYA

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DECLARATION AND RECOMMENDATION

Declaration

I hereby declare that this thesis is my original work and has not been submitted to this or any other University for the award of a degree or any other award.

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Recommendation

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

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DEDICATION

This research work is dedicated to my parents and family members who provided moral and material support during the study. Special dedication goes to my father John Seroney and my mother Margaret Seroney. It also goes to my wife Beatrice Kiplagat and children Victor Kipkogei, Millicent Jepkemboi, Collins Kipchumba, Faith Jelagat and Lynn Jeruto.

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ABSTRACT

Arid and Semi-Arid Lands are faced with environmental challenges which affect the productivity of their agricultural enterprises and consequently the level of food security and livelihoods of people. Tambach Ward in Kerio Valley of Elgeyo-Marakwet County is an ASAL area and Households living face similar challenges. The major farm enterprises practiced are maize, Drought-tolerant crops and livestock. Despite the support provided to households by Government and Non-Governmental Organizations through provision of agricultural extension services, funding of agricultural projects and provision of relief food supplies, food insecurity has remained high in the Ward. The purpose of the study was to investigate the relationship between choice of farm enterprises and food security among households living in Tambach Ward. The specific objectives of the study were to; determine the relationship between choice of maize enterprise and food security in Tambach Ward, determine the relationship between choice of drought-tolerant food crops enterprise and food security in Tambach Ward, and determine the relationship between choice of livestock enterprise and food security in Tambach Ward. A descriptive survey research design was used. Purposive, stratified and systematic sampling techniques were employed to sample respondents. A total of 120 household heads were sampled from 2,782 households in three locations namely Keu, Kiptuilong and Kamogich. Data was collected using structured interview schedule. The instruments were pre-tested by sampling 20 household heads in Cheptebo location in Chepkorio Ward. Cronbach Alpha was used to test the reliability of the instrument and a reliability coefficient of 0.80 was obtained which was above the recommended 0.70. Data was analyzed using both descriptive and inferential statistics. Pearson's Product Moment Correlation was used to determine the relationship between choice of farm enterprises and food security at 0.05 α level of significance. Hypotheses were tested using Multiple Regression. Analysis of variance was used to test whether the Multiple Regression models could significantly fit in predicting the outcome than using the mean. From the multiple regression model, R2 = 0.362. This indicated that the choice of maize, livestock and drought-tolerant food crops enterprise account for 36.2 per cent of food security along Kerio Valley. The study concluded that Livestock enterprise had a greater relationship with food security followed by Drought-tolerant food crops enterprise and maize had the least relationship. The high potential of livestock enterprise was due to its ability to withstand adverse environmental conditions than other enterprises. The recommendations of the study were; sensitization of households on diversification of farm enterprises and change of feeding habits from maize as a staple food crop to other alternative food crops, Government to enhance dry land farming technologies and promote drought tolerant food crop farming, Government and non-Governmental Organizations to improve marketing of livestock and value addition of livestock products to improve household income all of which enhance food security in Tambach Ward.

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LIST OF ABBREVIATIONS

AATF: African Agricultural Technology Foundation

ALRMP: Arid Lands and Resource Management Project

ASALs: Arid and Semi-Arid Lands

CADP: Comprehensive Agricultural Development Program

CADSAL: Community Agricultural Development in Semi–Arid Lands

CBPP: Caprine and Bovine Pleuro-pneumonia

CFS: Community Food Security

SCAO: Sub-County Agricultural Office

DLDP: Dry lands Livestock Development Programs

DRC: Drought Resistant Crops

DRS: Drought Recovery Seed

DT: Drought Tolerant

ERS: Economic Recovery Strategy

EWS: Early Warning System

FFAS: Food for Assets

FAO: Food and Agricultural Organization

FEWSNET: Famine Early Warning Systems Network

FNSP: Food Nutrition and Security Policy

GHI: Global Hunger Index

GMO: Genetically Modified Organisms

GoK: Government of Kenya

HFS: Household Food Security

ICRISAT: *Centro Internacional de mejoramiento de maizy Trigo/*International Institute for Semi-Arid Tropics

IFAD: International Fund for Agricultural Development

IFPRI: International Food Policy Research Institute

ISAAA: International Service for the Acquisition of Agri-biotech Applications

JICA: Japanese International Co-operation Agency

KFSN: Kenya Food Security Network

KFSSG: Kenya Food Security Steering Group

KFSTWG: Kenya Food Security Technical Working Group

KTBH: Kenya Top Bar Hive

KVDA: Kerio Valley Development Authority

MDG: Millennium Development Goal

MoALF: Ministry of Agriculture Livestock and Fisheries

NALEP: National Agriculture and Livestock Extension Programme

NEAPAS: National Environmental Adaptation Programmes of Action

NFPRI: National Food Policy Research Institute

NCPB: National Cereals and Produce Board

PRRO: Protracted Relief and Recovery Operation

SARDEP: Semi-Arid Development Project

SGR: Strategic Grain Reserves

SIDA: Swedish International Development Agency

SPFS: Special Program for Food Security

SRA: Strategy for Revitalizing Agriculture

UNICEF: United Nations Children Education Fund

USDA: United States Department of Agriculture

WEMA: Water Efficient Maize for Africa

WHO: World Health Organization

WFP: World Food Programme

CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

Food insecurity has remained high among households for many years. After decades of steady decline in food security situation, the trend in world hunger measured by the prevalence of undernourishment reverted in 2015 after the conclusion of Millennium Development Goals (MDGs). The number of people who suffer from hunger has slowly increased however more than 820 million people in the world are still hungry, underscoring the immense challenge of achieving the Zero Hunger target by 2030 (FAO,2017).

This recent trend is confirmed by estimates of severe food insecurity in the world based on the Food Insecurity Experience Scale (FIES), which is another way to monitor hunger. Hunger is on the rise in almost all sub regions of Africa, the region with the highest prevalence of undernourishment, at almost 20 percent (UNICEF,2017). It is also rising slowly in Latin America and the Caribbean, although the prevalence there is still below 7 percent. In Asia, where undernourishment affects 11 percent of the population, Southern Asia saw great progress in the last five years but is still the sub region with the highest prevalence of undernourishment, at almost 15 percent, followed by Western Asia at over 12 percent, where the situation is worsening (FAO, 2019).

The main indicator for monitoring progress on the eradication of hunger in the world reported in this report is the prevalence of undernourishment, or PoU (SDG Indicator 2.1.1). Beginning in 2017, the prevalence of severe food insecurity based on the Food Insecurity Experience Scale (FIES) was also included in the report as another, complementary indicator of hunger using a different approach (FAO, 2017). People experiencing moderate food insecurity face uncertainties about their ability to obtain food and have been forced to reduce, at times during the year, the quality and/or quantity of food they consume due to lack of money or other resources. It thus refers to a lack of consistent access to food, which diminishes dietary quality, disrupts normal eating patterns, and can have negative consequences for nutrition, health and well-being. People facing severe food insecurity, on the other hand, have likely run out of food, experienced hunger and, at the most extreme, gone for days without eating, putting their health and well-being at grave risk.

FAO has continually published the State of Food and Agriculture reports on annual basis since 1947. Advances in agriculture since then have achieved a quantum leap in food production, improved world food security and supported the structural transformations that have brought prosperity to a large part of the world population. However, with an estimated 815 million people worldwide still suffering from chronic hunger, and millions more living in poverty, much more remains to be done. Unless economic growth is made more inclusive, the global goals of ending poverty and achieving zero hunger by 2030 will not be reached. The international community must work together now to ensure that those "left behind" take their rightful place in a world serving people, planet, prosperity, partnerships and peace. To meet growing food demand, it is necessary to develop more productive and sustainable enterprise systems. Agricultural transformations in the late twentieth century relied on large-scale intensification using high levels of inputs. In many countries, that approach has resulted in severe environmental impacts, including massive deforestation, the depletion of soil and water, and high levels of greenhouse gas emissions.

Future transformations face unprecedented environmental constraints, requiring action to both mitigate and adapt to climate change and natural-resource scarcities. will need to reduce resource use in agriculture without compromising yields, and optimally manage livestock residues, a major source of greenhouse gases. Hurdles posed by excessive fragmentation of landholdings need to be overcome. Some 85 percent of the world's farms are smaller than 2 hectares. In most low-income and lower-middle income countries, small farms are becoming smaller, to the point where many are no longer economically viable. At the same time, in many sub-Saharan African countries, the number of medium-sized farms is increasing in high-potential areas. In the long term, the consolidation of farmland by investors may occur alongside the continuing fragmentation of land operated by traditional enterprise communities. Declining farm size may not necessarily hinder productivity, for although the labour productivity of small farms is low, they have the highest land productivity.

However, smallholders must have either the necessary scale to access markets and adopt new technologies; underscoring the importance of public rural services and collective action, or access to technologies that are specifically adapted to small-scale operations. Productivity can also be improved by strengthening property rights, essential for efficient land rental markets, which could help achieve economies of scale. Recent evidence suggests that land rental

markets are more common than previously though Progressive food security reports worldwide have indicated decline in food insecurity among the population but still require more effort to address it. According to FAO, IFAD and WFP (2013), a total of 842 million people in 2011–13, or around one in eight people in the world, were estimated to be suffering from chronic hunger, regularly not getting enough food to conduct an active life. This figure is lower than the 868 million reported with reference to 2010–12. The total number of undernourished people fell by 17 percent in the period 1990–92.

Food insecurity has continually proved to be a worldwide challenge despite the strategies put in place by governments. The year 2015 marked the end of the monitoring period for the World Food Summit (WFS) and Millennium Development Goals (MDGs) hunger targets. The projections advanced by FAO, WFP & IFAD (2015) suggest that, as a whole, the developing regions have almost reached the MDG 1 hunger target. From a statistical perspective, the target was missed by a small margin, but from a development perspective, the commitment was fulfilled, at least globally. The estimated number of undernourished people was 285 million above the envisaged target for 2015, which aimed at reducing by half the number of people that were food insecure in the year 2000 (FAO, WFP & IFAD, 2015). Three-quarters of those affected live in rural areas and include those who have been displaced by civil conflicts and also those who scratch their living from dry lands where adequate rainfall for crop production is a constant challenge (FAO, 2015a; FAO, 2015)

In Sub Saharan Africa, over 218 million people live under extreme poverty and hunger (MOA 2011). Agriculture provides livelihoods for about 80% of African population, most of whom are subsistence. In Malawi the introduction of large scale input subsidy program has seen the country switch from being a food beggar to becoming a net exporter of food. According to (Dorward and Chirwa 2011), ‘the program has changed the severe food shortage situation to increased food availability, higher real wages, economic growth and poverty reduction in Malawi.

Kenya is one of the countries with slow progress in achieving food security. The Government of Kenya admitted that some countries have already achieved their targets; others are still on their way, while some, including Kenya, are not expected to realize their objective (GoK, 2011). Food security reports generated in Kenya by different stakeholders testify the

magnitude of food insecurity in Kenya. The country was increasingly depending on food import/aid as it had continued to import maize, wheat, rice, powder milk and sugar.

In response to this situation in Kenya, food security initiative projects have been implemented over the years in Arid and Semi-arid areas but success of these 6 initiatives seem to be far from realization. According to Lewis, (2005), the only truly successful project is the one that delivers what it is supposed to, gets results, and meets stakeholder expectations. The food security projects have never delivered results as per the stakeholders' expectation. This is because food security still continues to be elusive in this area and the community is depended on relief food provisions from year to year. Although Kenya's agriculture and hence food security are highly weather dependent, the effective use of home-grown sectoral early warning systems- dealing with the various agro-ecological zones has not been adequately exploited. Such systems are intended to assist in identifying surplus, and deficit areas, in order to fill in the production gaps. The extreme climatic and weather events are common in many parts of the country and are associated with severe social and economic impacts such as famine, shortages of water, and energy. Other problems include shortages of many other basic needs, disease outbreaks, and disruption of trade, which are all aspects of poverty.

According to a food security baseline surveys carried out by various organizations over the years, reports indicate prevalence of food insecurity in Kenya. Food security in Kenya is mainly transitory in nature and occurs both in the rural and urban areas, in the medium and high potential areas and in arid and semi-arid lands (ASALs). This is due to poor agricultural productivity and inefficient food distribution system, high population growth, unemployment, high prevalence of HIV/AIDS, and landlessness despite large chunks of idle land owned by the state or individuals (JICA & GoK, 2006).

Food insecurity in Kenya, especially the marginal areas, has led to high incidences of malnutrition due to the declining production of maize as a staple food crop. Over reliance on maize as a staple food crop as is the case in Kerio Valley, may be attributed as one of the causes of food insecurity in Kenya (SCAO, 2007). Alternative enterprises need to be identified to address food insecurity in Kenya. In the past decade, it was estimated that more than 50 percent of Kenya's population was food insecure, most of them in the pastoral and marginal areas (Keiyo North Sub-county Agriculture Office, 2007). Food aid was received from various donor agencies targeting mainly emergency and vulnerable groups. More

Kenyans were in need of emergency food in 2009 than they were 20 years ago and the situation was projected to worsen as indicated by the International Food Policy Research Institute (IFPRI) report for 2009.

Global Hunger Index (GHI), that measures levels of malnutrition and hunger showed that Kenya's hunger rating had moved from "serious" to "alarming". Kenya was considered a hunger hot spot and the index showed that it had been falling in food security for the last 20 years compared with other countries (Gachiri, 2009). The Kenya Food Nutrition and Security Policy (FNSP) prepared in 2011 showed that over 10 million people in the country suffered from chronic food insecurity and poor nutrition, and between two and four million people require emergency food assistance at any given time. Nearly 30% of Kenya's children are classified as undernourished, and micronutrient deficiencies are widespread (GoK, 2011).

A decade later, food security index for the country indicates high prevalence of food insecurity demonstrating the persistence of food security in Kenya. This can be attested by the global ranking on food security. In the 2019 Global Hunger Index, Kenya ranked 86th out of 117 qualifying countries. With a score of 25.2, Kenya suffers from a level of hunger that is serious. (GHI, 2019)

Food security is anchored in the constitution as one of the important rights of the Kenyan people. "Article 238 (1) of the Constitution provides that one of the principles of national security is the protection of all the citizens of Kenya, their rights, freedoms, property, peace, stability, prosperity and other national interests. Some of the rights of all Kenyans that are protected include the right to be free from hunger, to have adequate food of acceptable quality and uninterrupted supply of clean and safe water in adequate quantities at all times." Kenya is currently facing challenges arising from global phenomena, notable among these being global warming (climate change), and global food and financial crises (GoK, 2011).

Kenya is a member country to UNDP and embraced SDGs to meet its food security target. At the close of MDGs in 2015, nearly 1 out of every 9 people worldwide still faced hunger. As a follow up to the strategy, post 2015 development agenda was set by world Governments; Sustainable Development Goals (SDGs) to be achieved by 2030. The goal on eradication of hunger and undernourishment was set as SDG 2: End hunger, achieve food security and improve nutrition and promote sustainable agriculture (UNDP, 2014). While the MDGs'

hunger eradication goal focused on caloric intake, the SDGs process has emphasized the nutritional value of food as well (SIANI, 2014).

Food security has been identified as one of the pillars to promote economic development in Kenya. The government has laid strategies to achieve food security in the country. The country still experiences food insecurity among the population in various parts of the country and seasons of the year. This is in various aspects; inadequate food, inability to buy food, poor accessibility to food markets and poor nutritive value of the food consumed among households. The choice of appropriate farm enterprises as advocated in this study is one of the cost-effective strategies to achieve food security. Addressing food security is an important pillar of vision 2030 and Sustainable Development Goals in Kenya and achieving food security is paramount in promoting national development in the country.

The study was carried out in Elgeyo Marakwet County. Administratively, the County is divided into four Sub-Counties namely; Marakwet East, Marakwet West, Keiyo South and Keiyo North. These are further subdivided into 15 Wards, 69 locations and 203 sub locations. The County is divided into three topographic zones namely; the highlands, the escarpment and Kerio Valley. The highlands constitute 49% of the County, Escarpment 11% and Kerio Valley 40%. Escarpment and Kerio Valley have poor soils, low rainfall and are prone to natural disasters such as drought and landslides. The area has sparse population due to the harsh climatic conditions in conjunction with high cases of insecurity and high poverty levels (Elgeyo Marakwet County, 2013). Keiyo North Sub-County is made up of two administrative Wards namely; Tambach and Kamariny and four wards namely Kamariny, Kapchemutwa, Tambach and Emsoo. Tambach Ward lies both along the escarpment and Kerio Valley. Food insecurity along the valley is higher than the other zones (County Government of Elgeyo Marakwet, 2013)

Some of the major factors that have contributed to food insecurity along Kerio Valley of Tambach Ward include high cost of food production, adverse weather conditions, increased land sub-Ward, livestock diseases, inadequate irrigations and poor agricultural policies (JICA & GOK, 2006; DAO, 2007). Other factors include; human-wildlife conflict and cattle rustling by the Pokot people, who border Tambach Ward on the Northern part (World Vision Kenya, 2008). Within the existing environmental and technological conditions, choice of farm enterprises may be a critical factor influencing food security in Tambach Ward.

Non governmental organizations played a critical role in the past to address food security in Tambach Ward with notable efforts put by JICA and WVK. However, food security levels were found to be low in the Ward with 62 percent of people being food insecure according to a baseline survey in the area of study by JICA & GOK (2006) and 75 percent according to WVK (2008).

Progressive reports from varies agencies have demonstrated that residents of Elgeyo-Marakwet County where Tambach ward is located exhibit high levels of poverty and food insecurity. A ministry of Agriculture report indicates that fifty-seven percent of the total population lives below the poverty line. The situation is worse for residents of Kerio Valley where estimation of poverty levels is as high as 67 percent. Among the poor populations, 56 percent are from rural areas and the remaining 44 percent are in urban areas (MoALF, 2017)

Food insecurity in the County also remains high at fifty-five percent of the population suffering food poverty. The ministry reported that unavailability of food for the County is seasonal and influenced mostly by rain fed production coupled with poor storage and distribution systems. A considerable amount of food produced during the rainy season is lost through post-harvest losses as there are inadequate storage facilities. Because of the bad roads, farmers have difficulties in getting their produce to the market and traders who offer very low prices exploit them. Unpredictable and insufficient rains coupled with limited use of yield-enhancing inputs lowers productivity. Production under rain fed conditions requires proper choice of enterprises especially in the arid areas of Kerio Valley where farming activities are vulnerable to weather conditions.

The main source of livelihoods is income from both livestock and crop farming. In the Highlands, farmers keep dairy cows and sheep for wool and produce potatoes, maize, wheat, and beans. In the Kerio Valley, they keep goats and sheep and produce fruits, millet, sorghum, groundnuts, and green grams.

It is imperative that sustainable food security strategies should be initiated and developed organizations to allow resources to be channeled to farm enterprises with greater potential to address food insecurity. This will reduce food aid which is costly and less sustainable as well as ensuring donor funds in aid of food security projects are directed to appropriate farm enterprises. Improved food security mechanisms will work towards zero hunger by 2030 leading to the attainment of the second Sustainable Development Goal (SDG). Inappropriate

choice of farm enterprises by households in Tambach Ward is perceived to be one of the causes of food security in the area. Little information is available to explain why households in Tambach Ward have continued to grow maize as a staple food crop yet it is vulnerable to adverse weather conditions than other farm enterprises such as drought-tolerant food crops and livestock enterprise which are less vulnerable to these conditions.

1.2 Statement of the Problem

Kerio Valley is considered as an Arid and Semi Arid Land (ASAL). Households practice small holder mixed farming to meet their food needs. Food security has remained low in Kerio Valley of Tambach Ward for many years despite the strategies put in place by the Kenyan Government and Non-governmental organizations through provision of agricultural extension services and food security support Programmes. The major farm enterprises practiced by households to address their food needs are maize, Drought-tolerant and livestock. Households have laid more emphasis on maize enterprise to provide them with their food needs. Drought-tolerant food crops and livestock enterprise are also practiced but with low emphasis. Little empirical evidence is available on relationship between choice of farm enterprises and food security among households which can inform on the farm enterprises with greater potential to address food insecurity in Tambach Ward, Kerio Valley.

1.3 Purpose of the study

The purpose of this study was to investigate the relationship between choice of farm enterprises and food security among households living in Kerio Valley, Tambach Ward, Elgeyo-Marakwet County. The study investigated relationship between choice of major farm enterprises and food security; maize enterprise, drought-tolerant food crops enterprise and livestock enterprise.

1.4 Objectives of the Study

The following objectives guided the study:

i. To determine the relationship between choice of maize enterprise and food security among households living along Kerio Valley, Tambach Ward.
ii. To examine the relationship between choice of drought-tolerant food crops enterprise and food security among households living along Kerio Valley, Tambach Ward.
iii. To establish the relationship between choice of livestock enterprise and food security among households living along Kerio Valley, Tambach Ward.

1.5 Hypotheses of the study

The following hypotheses were derived from the objectives of the study;

$H0_{1:}$ There is no statistically significant relationship between choice of maize enterprise and food security among households living along Kerio Valley, Tambach Ward.

$H0_2$ There is no statistically significant relationship between choice of drought-tolerant food crops enterprise and food security among households living along Kerio Valley, Tambach Ward.

$H0_3$: There is no statistically significant relationship between choice of livestock enterprise and food security among households living along Kerio Valley, Tambach Ward.

1.6 Significance of the Study

The findings of this study may be useful to households in selecting appropriate farm enterprises that meet their food security needs to alleviate the persistent problem of food insecurity in Kerio Valley. It also helps agricultural extension staff to lay more strategies in provision of agricultural services to those enterprises with greater potential to enhance food security. The Non-governmental organizations may benefit through easy identification of food security projects to support, hence investing resources on enterprises with high food security potential. Improved food security reduces the cost of relief food supplies by the Kenyan Government that assist in working towards the attainment of the second Sustainable Development Goal which sets targets to end hunger, achieve food security and improve nutrition and promote sustainable agriculture which is targeted to be achieved by 2030.

1.7 Scope of the Study

The study focused on the relationship between choice of selected farm enterprises and food security among households living in Tambach Ward. The study only considered the major farm enterprises which are practiced by households that contribute to food security. It investigated the contribution of maize enterprise, drought-tolerant food crops enterprise and livestock enterprise on the provision of sufficient, accessible, affordable and nutritious food to households in the Ward. It also established factors determining the choice of the selected farm enterprises and the extent to which households practice the enterprises. The study was conducted in three locations along Kerio Valley of Tambach Ward namely Keu, Kiptuilong and Kamogich. Kokwao location was not included in the study because it lies in the escarpment with different ecological characteristics from the three locations along Kerio Valley. Households were more food secure than the locations of the study.

1.8 Assumptions of the Study

The following assumptions were made in this study:-

i. The selected farm enterprises; crop enterprise, drought-tolerant food crops enterprise and livestock enterprise, offer major support to food security in Tambach Ward while the level of contribution of the less practiced cash crop enterprise towards food security is minimal.

ii. All respondents were cooperative and provided reliable responses during the study.

1.9 Limitations of the Study

This study faced the following limitations:

i. The study was dependent only on the respondent's feedback whose accuracy could not be ascertained. This was mitigated by probing respondents during interviews of households and obtaining information from Agricultural Extension staff.

ii. The study was conducted along Kerio Valley in Tambach Ward as an ASAL area and not other agro-ecological zones. The findings are only generalizable to Kerio Valley but not other areas of Elgeyo Marakwet County. Purposive sampling was used to identify the locations with similar characteristics to achieve the objectives of the study.

iii. Challenges were experienced while collecting food security data in the expansive study area of Kerio Valley with poor communication network. The researcher took time to move from one location to another using the available means of transport.

iv. In some cases, collection of primary data was not feasible due to lack of information. Reliance on secondary data collected by multiple agencies became necessary in such cases which required more time. The researcher took time to collect relevant information.

1.10 Operational Definition of Key Terms

For the purposes of this study, the following operational definitions applied:-

Drought-tolerant food crops Enterprise: It refers to farming of food crops that can withstand adverse environmental conditions which include high temperatures and little or no rain grown. In this study it refers to the growing of millet, sorghum, groundnuts and green grams by households in Tambach Ward.

Farm Enterprise: A large or important agricultural activity especially one that is new or different. In this study it refers to major enterprise activities practiced by households in Tambach Ward that contributed to food security such as maize enterprise, drought-tolerant food crops enterprise and livestock enterprise.

Food Insecurity: A condition in which people lack basic food intake to provide them with the energy and nutrients for major productive lives (USDA, 2005). In this study it refers to conditions where farm enterprises cannot provide the recommended average monthly requirements per person of 13.7 kg of carbohydrates, 2.6 kg of proteins and 0.75 kg of fat (MOA, 2007).

Food Security: A situation when all people at all times have both physical and economical access to sufficient food to meet their dietary needs for a productive and healthy life (USAID, 1986). In this study it refers to that situation when all people in the study area have sufficient, accessible and affordable food of sound nutritional utilization to meet their dietary needs for a productive and healthy life.

Food Security Indicators: Factors which show food security status as indicated by different parameters. There are two main categories of food security indicators;

1) **Process indicators**-They are measures of food security which show household availability, access, affordability and nutritional utilization, and;

2) **Outcome indicators**, which are measures of food security which show household food consumption.

- **Food availability**-Describes amount of food produced by households from each enterprise and adequacy of food throughout the year. In this study it refers to amount of crop produce in bags and kilograms in livestock products. Adequacy was measured by the period the products were available to households in year.

- **Food accessibility**-Refers to the frequency with which households reach physical markets to buy food.
- **Food affordability**-It is the ability of food consumers to buy food as determined by household income and price of food in the market.
- **Nutritional utilization**-Refers to the frequency with which households consume balanced diet as indicated by 24-hour dietary recall. A 24-hour recall of food consumption collects information on food intake over 24-hour period. The household member in charge of food preparation is the preferred respondent.

Livestock Enterprise: Refers to keeping of livestock to produce products for subsistence or commercial use. In this study it refers to the keeping of common livestock namely cattle, sheep, goats and bees.

Maize Enterprise: Refers to the growing of maize crop for subsistence or commercial use. In this study it refers to growing of maize crop for consumption by households or to be sold to generate income to buy other food stuffs for household consumption.

Rural Livelihood: The process by which households construct a diverse portfolio of activities and social support capabilities for survival, (Ellis, 1998). In this study it refers to farm and non-farm activities that households in Tambach Ward rely on to provide for their daily requirements.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter covers literature reviewed related to the objectives of the study. It consists of sections on enterprise choice and food security, food security indicators, Maize enterprise, Drought-tolerant food crops enterprise, Livestock enterprise and current food security intervention measures in Tambach Ward. It also discusses the theoretical and conceptual frameworks of the study.

2.2 Farm Enterprise Choice and Food Security

The definition of food security has evolved over the last 30 years to reflect changes in thinking, knowledge and practice. The World Food Conference in 1974 defined food security in terms of food supply: assuring the availability and price stability of basic food stuffs at the international and national levels. Since then, the definition has been progressively revised to include the individual and household levels, the distinction between chronic food insecurity, associated with problems of continuing or structural poverty and low incomes, and transitory food insecurity, which involves periods of intensified pressure caused by natural disasters, economic shocks or conflict. On-going discussions within the Committee on World Food Security have aimed at further integrating nutrition into consideration by coining the concept of "food and nutrition security". Ethical and human rights dimension of food security have gradually come into focus.

In 1996, a milestone was set with the consideration of the right to adequate food at the World Food Summit. It pointed the way towards the possibility of a rights based approach to food security. In 2004, the FAO Council adopted the "Voluntary Guidelines for the Progressive Realization of the Right to Adequate Food in the Context of National Food Security". Since then, the right to food has been promoted in various reference documents of global relevance such as the Declaration of the Summit on World Food Security (FAO 1996, 2002), the Updated Comprehensive Framework for Action (UN HLTF, 2010) and the Global Strategic Framework for Food Security and Nutrition (CFS, 2012).

Globally estimated 500 million family farms (over 88% of all farms) produce more than 70% of the world's food on 75% of the total agricultural land. Small farms (less than 2 hectares)

operate about 12% of the world's agricultural land. On 30% of the agricultural land in 83 countries in Asia, sub-Saharan Africa and Latin America, 380 million households are enterprise on less than 5 hectares (FAO, 2018).

These households produce more than 70% of the food calories produced in these regions. They are responsible for 53% of the global production of food calories for human consumption and more than three-quarters of the planet's rice. Within these 83 countries, units of five hectares or less account for more than half of the production of eight staple crops by mass: rice, groundnut, cassava, millet, wheat, potato, maize, barley, and rye. In environmental respects, projections by the UN Convention on Biological Diversity perceive agriculture as responsible for around 70% of the projected loss of terrestrial biodiversity globally. Agriculture is also seen as a major contributor to greenhouse gas emissions, with estimates of its contribution ranging from 10% to 45%. While large advancements in eradicating hunger have been made and food production has dramatically increased globally, it is telling that in a number of countries of high food insecurity the food production levels remain similar to those of the 1960s(FAO,2018)

The level of agricultural production majorly depends on the prevailing environmental conditions of particular area especially climatic, edaphic, cultural and technological factors. Land use in different parts of Kenya and subsequent choice of farm enterprises may be controlled by one or more of these factors. Studies conducted in Tanzania, concluded that from the ecological point of view, land use patterns or choice of farm enterprises are a result of the ways in which rainfall and soils combine to provide distinct productive potentials. The significance of ecological factors in determining choice of farm enterprises lie in the fact that potentially productive areas are few and randomly scattered all over the country and a large part of the country require institutional, technical and financial inputs to realize full potential (Mlay, 1981).

The Food and Agriculture Organization (FAO) estimates that small scale produce nearly 70% of the total world food supply (FAO, 2013, p.22). However, most of them are unable to produce enough food or earn enough income to meet their own household's needs, as explained by the UK Food Group (2010, p.1). A study by the World Food Programme (2013) also underlines how agricultural households are more vulnerable to food insecurity than urban ones, and are also the ones in which diversification of food is lowest and where the

share of income spent on food is the highest (more than 75%). It is indeed curious to see that those most active with the production of food are often also those that have the least food in their hands at the end of the day.

The world population is expected to grow by 2.6 billion people between 2008 and 2050, and the demand for food is going to increase drastically over the coming decades (Miller & Spool man, 2012, p.122). Industrialized agriculture and high input agriculture has the aim to constantly maximize the yield to meet the increasing demand for food. It today produces around 80% of the world's food (Ibid.). Industrial agriculture and globalization often triggers economic, ecological and social challenges which have negative impact on public health, ecosystems, food quality and can disrupt traditional rural livelihoods (Altieri, 2009). One form of industrialized agriculture is presented in big monoculture plantations, especially established in tropical developing countries (Miller & Spool man, 2012). Such plantations imply many challenges, such as the loss of biodiversity in general and the diversity of agricultural crops in particular. By, for example simplifying genetic codes the risk of epidemic hazards rises (Wognum et. al, 2010).

In Africa there is contradiction is what was experienced especially in Tanzania in the years 2014 and 2016, and inspired me to investigate this issue further through this study. It was difficult to understand why and how, in a country where around 80% of the population are hunger stricken, over a third could be undernourished. This thesis will unveil the historical and political reasons why this is the case, and offer a possible explanation to the contradiction that sees small-scale worldwide producing the majority of food but at the same time suffering most from food insecurity. The issues of hunger and inequality have been analyzed by many scholars over the years, and has gained more and more coverage over time, so much that the terminology such as 'food security', 'the right to food', and 'food sovereignty' are now commonly used to refer to specific branches of the literature that have explored the topic and the problems of food in connection to politics, economics, and sociocultural factors.

In Kenya, drought conditions are frequent and widespread, covering Northern sub-counties, Southern and Northern Rift Valley (Trans Mara, Narok, Bomet, Baringo, Keiyo, Marakwet and West Pokot), parts of Central Kenya and areas between the Coast and Eastern highlands. The level of crop production is low in these areas with low annual rainfall which is poorly distributed (Conen & Lewis, 1991). The livestock sub-sector is very important to the local

communities in these ASAL areas. ASAL rangelands are complex fragile ecosystem to manage with emerging changing lifestyle of nomadic pastoralists. This is further compounded by prevalent livestock diseases, cultural practices in terms of resource tenure, access rights and use of inappropriate technologies which need to be given more attention (KARI, 1998).

The relationship between choice of enterprise and food security can better be understood by exploring the role that agriculture has on food security and nutrition in developing countries. This linkage can either be direct or indirect (Dorp et al., 2012). The direct linkage between agriculture and food security is observed through increased availability and accessibility of better quality foods obtained as a result of improved farm production, farm diversification, the use of improved breeding stock and post-harvest technologies that ultimately lead to the improved household food consumption, either through subsistence level consumption or via income (Dorp et al., 2012). Indirect effects of agriculture on food security might occur through the growth of the agricultural sector as a whole, freeing up labour forces for alternative economic activities, through lowering food prices because of increased availability and accessibility to food, or changing food policy at national level (for instance, those policies which influence food prices) (Haddad, 2000). Generally, there are five pathways through which agriculture and food security are linked (Dorp et al., 2012; Haddad, 2000; Hawkes and Ruel, 2006; Hawkes and Ruel, 2008; World Bank, 2007).

First, increased (nutritious) food production for own consumption. Food and (micro) nutrient consumption is directly affected by the types and quantities of foods that households produce, especially in the case of subsistence agriculture. Second, increased income from the sale of agricultural commodities and greater farm productivity. This pathway only contributes to improved nutrition if the greater farm income is translated into adequately purchasing of nutritious foods. Third, increased empowerment of women as key contributors to household food security and to the health and nutrition status of household members. Through greater control and decision-making powers by women in both the productive and domestic domains, women's preferences and priorities are more reflected in the agriculture-nutrition chain; fourth, lower food prices resulting from increases in food supply. A decrease in food prices leads to a de facto increase in income. This could lead to improvements in nutrition if this means households are actually purchasing more nutritious foods. Fifth, macroeconomic

effects of agricultural growth (i.e. increased national income, macroeconomic growth and poverty reduction).

Economic growth might contribute to improvements in the food and nutrition status. However, the impacts of growth can be distributed unevenly across households, with many poor not benefiting. The pathways outlined above are dynamic and overlap in time as a result of changes in technologies, agricultural policy, food consumption patterns and markets (World Bank, 2007). Many development initiatives in agriculture focus on promoting direct effects, in particular, by increasing both farm production and households' incomes. The indirect effects of agriculture on food security and nutrition potentially occur through the resulting lowering of food prices and/or income increase. Many food insecure households in rural areas are net food buyers and thus benefit from lower food prices.

Farm households present the point where most household decisions related to production, investments, marketing, conservation, resource allocation and responsibilities of household members are made (French, 1995). Household choice of enterprise does not take place in a linear fashion; rather, it results from the interaction of many factors. Understanding and modeling the processes and consequences associated with decision-making among farm households has been one of the primary concerns for researchers and scholars in the field of development studies (Borges et al., 2015a; DFID, 1999; Malawska and Topping, 2016; Willock et al., 1999).

Available resources on theories of farm household decision-making processes are diverse and tend to reflect specific context/discipline (Pannell et al., 2006). For instance, a scoping review of the theories of behavior by Davis et al. (2015) identified about 82 theories which exist across the disciplines of psychology, anthropology, sociology and economics. As a result, most of the theoretical models which explain farm household decision-making process have provided discipline-guided explanations ignoring the fact that decisions undertaken by the farm household usually result from the multifaceted factors (Borges et al., 2015a; Edwards-Jones, 2006).

It is argued that the discipline-guided explanations of household decision-making process have created a theoretical gap in the literature by failing to provide a theoretical model with formal integration of variables from all disciplines (Borges et al., 2015a). To understand how households arrive at such decisions, this part discusses some of the theories related to farm

household decision making process, with particular reference to Expected Utility Theories (EUT) and the Theory of Planned Behavior (TPB).

The additional farm income might be spent on food purchases, differentiation of food purchase, or on education, clean water, hygiene and preventive and curative health care. In practice, however, many studies have shown that an increase in household income does not necessarily translate into increased household food security and/or nutritional wellbeing (Haddad, 2000; World Bank, 2007). Income controlled by women is more likely to be spent on feeding the household than income that is controlled by men (World Bank, 2007).

The article continues to add that increasing incomes might even have negative effects on food and nutrition security if they are accompanied by additional labour needs, 48 especially for women, and interfere with (child) care. Additional income might not be spent on food, but households might prefer non-food uses such as education, improved housing or productive assets. Additional labour needs and/or status might also lead to a different food basket, including food products that can be easier prepared, but are also of lower quality (fast food, noodles and white bread).

Development of agricultural technologies appropriate for the marginal areas is usually needed (Olembo, 1989). Within appropriate technologies, suitable choice of farm enterprises will further enhance food security in ASAL areas such as in Tambach Ward of Keiyo North Sub-county. Land use remains communal in Kerio Valley; a factor which has adversely affected the choice of farm enterprises and the level of food production. The elders' control all pastoral and agricultural land rights among the community members and distribution of land is based on lineage and clan structures (JICA & GOK, 2007).

Appropriate choice of farm enterprises is a key aspect in increasing agricultural productivity, reducing risks in farm enterprises and improving food security. According to JICA and GOK, (2006) they reported that along Kerio Valley, environmental constraints have led to the development of 17,401 hectares under irrigation for crop production out of the potential 63, 903 hectares. The remaining land is used for livestock production under free range system. In crop production, the crops grown are; cereals (maize, millet and sorghum); legumes (beans, pigeon peas and cowpeas); root crops (sweet potatoes, cassava and groundnuts); and fruits (citrus, mangoes, bananas, pawpaw and watermelon) These crops have a high potential in the

area but production levels are affected by their degree of resistance to adverse environmental conditions.

The choice of crop enterprise in Tambach Ward varies in terms of types of crops grown and acreage under production. More than 50 percent of the households do not cultivate any land and of those cultivating, 35 percent cultivate less than two acres. In the 2007 harvest season, 75 percent of the harvested less than 10 bags of grain with no or poor storage. using technologies such as farm machinery and improved enterprise methods constituted 40 percent; while 60 percent employed traditional technologies. The level of production for different crops has been varying over the years (WVK, 2008). in Tambach Ward prefer to grow maize as one of the farm enterprises to address food insecurity, despite the crop failure occasioned by low amounts of rainfall. Low emphasis is given to drought-tolerant food crops and livestock enterprise s though they form major enterprises that may deal with food insecurity in Tambach Ward.

2.3 Choice of Maize Enterprise and food security

Maize is one of the major staple food crops grown in many parts of the world. The level of production of the crop consequently influences food security. There are many challenges affecting the production of the crop which include climatic conditions, technological factors, feeding habits and preferred use among others. There has been a gradual reduction in the levels of food stock worldwide, mainly cereals since the mid 90's. Global stock levels have been declining by 3.4 percent annually. This decline underscores the importance of supporting domestic production as well as diversification of food production and consumption (GoK, 2011).

Maize is the most widely grown staple crop in Africa with more than 300 million dependents. 70 percent of people in Africa rely on agriculture, especially maize enterprise for livelihoods and food security. Maize cultivation in Africa has been facing constant threats of drought as three-quarters of the world's severe droughts have occurred in Africa in the past 10 years (Africa-Science, 2009).

Currently in Africa there are many international organizations working in close collaboration to achieve long- term goal to solve food security issues (Africa-science, 2009). Several organizations have put considerable effort in Kenya, especially in the ASALs with the objective of making communities food secure. This objective is yet to be achieved.

Consequently, the country imports maize or relies on food aid from other countries as a mitigation measure during times of shortage.

Kenya, just like in many other countries in the world, also relies on maize as an important food crop. Maize being a primary staple food crop is grown and consumed by most people in Kenya. It's a major source of carbohydrates for about 96 percent of Kenyans, and over 75 percent of total maize output is produced by smallholder. The production of the crop is affected by many factors such as technology, climate change, edaphic factors, pests and diseases among others. Although maize production may have increased per unit area, per capita maize production is still low.

The per capita supply of maize in Kenya has been declining since early 1980's as follows; 1963(116kg), 1999 (83kg) and 2007(73-50kg). Total maize production and maize yield per unit area in Kenya has been affected by many factors. Among the most important are the small total planted area and low productivity levels. 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 (Kenya Soil Survey, 1987; Muchena, Mbuvi & Wokabi, 1988) Between the 1970s and 1980s; rapid technology adoption accelerated national maize production from 1 tonne per acre or 1.5t/hectare respectively. Although maize productivity varies, today only 1.8 tonnes per hectare is realized against the potential of 6 tonnes per hectare. Despite efforts to promote productivity by enhancing technologies, output has declined against ever-increasing consumer demand. This is compounded by aspects of climate change. This has transformed the country into net grain importer (WFP, 2016)

The level of production of the crop varies between seasons and areas as dictated by the amount of rainfall due to over reliance on rain fed agriculture. For instance a MOA report for 2010 indicated that most parts of Kenya recovered from the little rain received in the year 2009 with exception of ASAL areas especially parts of North Western pastoral sub-counties that experienced mediocre long rains (MOA, 2010).

The trend on maize production in Kenya has been on the decline indicating the risk on overreliance of maize as a food security crop in many parts of the country including Tambach Ward. Maize production was expected to decline by 24.3 percent to 28 million bags in 2017 from 37 million bags in 2016, against the country's food security requirement of 40 million bags as reported by Cytonn Investments (2017) The decline was attributed to army worm

invasion in the key maize-producing regions in the country that is expected to cut production by approximately 5.0 percent and poor weather conditions for maize production characterized by rainfall shortages in maize-rich Uasin-Gishu and Trans-Nzoia Counties, expected to cut production by a further 20.0 percent.

"This is likely to exert upward pressure on food prices come 2018, thus leading to an increase in the inflation rate and could also have an impact on the currency as the country imports maize to bridge the gap," says the Analysts. Following late and below-average March – May 2017 long rains across most of the country; there has been a steady decline in household food security, especially in most of the pastoral and marginal agricultural areas (FEWS NET, 2017). This indicates the precarious situation maize enterprise faces in Kenya due to effects of weather changes. In Tambach Ward which is an ASAL area the effect is worse when households engage in the production of maize as a food security crop. Producing higher yields of maize on existing cultivated land is therefore the surest way of generating the extra maize grain required to feed the nation, which may be a difficult task.

To achieve the goal of higher yields, a number of remedial measures must be put in place which include enhancing the productivity of fragile marginal land ecosystems through improving existing maize varieties, devising techniques to improve rain water utilization, developing effective residue management practices, intensification of research to determine the appropriate types and quantities of fertilizers, manures and agricultural lime for different soils and climatic conditions of the country, boosting agricultural extension services, increasing agricultural credit and putting in place maize production and marketing policies that encourages to increase maize production on a sustainable basis (Wokabi, 2010).

The challenges of maize production demonstrate the need to adopt strategies that improve production. One of these strategies is proper choice of farm enterprises based on the prevailing conditions to address effects of climate change. In Kerio Valley, it makes it difficult for maize crop to meet household food security needs especially in the marginal areas. Apart from growing maize, one of the fundamentals of realizing food security is the development of drought-tolerant food crops varieties which are also high yielding. This could be attained through biotechnology and genetic engineering to make crops drought, salt and temperature tolerant to improve yields. The ability of small scale farmers to adopt integrated

crop management practices to mitigate drought impacts is another possible way (Africa-Science, 2009).

The latter is based on appropriate choice of farm enterprises suitable to specific agro-ecological zones to reduce the risk of low yield due to climatic effects; this forms an important basis for this study. In the marginal areas, including Tambach Ward, where maize production faces challenges, appropriate farm enterprises suitable for the ecological zone must be identified and developed. in Kerio Valley are perennial maize producers. However, low yields of the crop are annually reported due to unfavorable weather conditions. Crop failure is a common phenomenon due to the arid conditions. Statistics indicate one successful rain, and thus crop harvest once in every five years (JICA & GOK, 2006).

In Tambach Ward households practice small-holder mixed farming. Maize is grown as a staple food crop although crop failure is experienced frequently due to adverse weather conditions. Statistics indicate one successful rain, and thus crop harvest once in every five years (JICA & GOK, 2006).

A baseline survey conducted by World Vision Kenya in 2008 in Tambach Ward revealed that 74% percent of grain yields come from sorghum. Maize crop, like other cereals is produced by most households in small scale farms of less than two acres and average yields of less than 10 bags obtained from the same area (WVK, 2008). While most households do not store their produce due to low levels of production, most of those who store use granaries and sacks, all of which lead to post harvest losses due to pest attack leading to food shortage. A cereals collection Centre in Tambach Ward run by National Cereals and Produce Board (NCPB) closed in 1990 due to low maize production. in the Ward have neither outlet for their produce nor storage for relief food supplies. The lack of other marketing bodies makes access or sale of maize food difficult in the area (DAO, 2007).

In this respect Government and Non-Governmental Organizations intervened by supplying the residents with relief food supplies, mainly maize, on annual basis and Drought-Recovery Seed (DRS), though the problem of food insecurity has persisted in Kerio Valley. In 2007, the Kenyan Government supplied 24,600 kilograms of DRS for maize, cowpeas, green grams, groundnuts and sorghum, an indication of the effects of poor weather conditions in the area (DAO, 2007). The level of maize production in the Tambach Ward has generally been low as is evident from the amount of DRS supplied. Despite the high emphasis given to

maize enterprise by households as compared to other enterprises, maize has registered low yields not commensurate to the food needs of the community, a factor which may have influenced food security negatively in the Ward.

2.4 Drought-tolerant food crops Enterprise and food security

The major challenge to food security in Kenya is the perception that 'food is maize'. On the contrary, indigenous food crops, which are drought-tolerant, can act as an alternative source of the much-needed nutrients. The advocacy for indigenous foods has been triggered by the fact that the climatic conditions of dry areas cannot support maize and more so achieve its production potential. There are many grain and root crops that are high yielding and drought-tolerant which can contribute to food security in the dry areas of the country (Mataruka, 2010). The shift to drought-tolerant food crops enterprise is not only confined to Africa but also other parts of the world. For instance, in rain fed regions of Australia and North America, investment in Drought-tolerant food crops (DTC) are expected to bring large profits. Among the poor in developing dry land areas, gains from DTC could make the difference between survival and starvation. During a drought, DTC could limit catastrophic losses and help households recover more quickly. Many proponents argue that adopting DTC varieties may also allow households to become more entrepreneurial and diversify their livelihoods. In the past decade, more than US $ one billion has been spent on drought tolerance in agriculture research and much is being done. This is in light with climate change, growing water insecurity and renewed concerns about food security (Lybbert, 2010).

Some of the initiatives which have been started in Kenya to promote the growing of DTC include the RINCOD project. In its contribution towards spearheading food security effort in Kenya, RINCOD has initiated the following approach: sensitization on agricultural productivity, diversification, formation and training of production groups, enhancing group's skills in value addition, promotion of indigenous crop enterprise as a business and establishment of cottage industries. This study supports sensitization on food security through agricultural production diversification by promoting indigenous crop enterprise. Some of the success stories of the RINCOD project have been reported in some parts of Kenya (Mataruka, 2010).

Mataruka, (2010) further indicated that in Muranga, groups started production of indigenous foods and have obtained good results, while in Mutomo Sub-county RINCOD cassava project

has established a drought-tolerant cassava (*Manihot esculanta*) with an overall objective of enhancing food security. As a drought-tolerant food crops, cassava has many advantages such as: it can survive harsh climate where other crops may not do well, grows in low-nutrient soils, roots can be stored in the soils for between 24 to 36 months; providing a good preservation method for the food reserves for household, leaves act as vegetables providing proteins, vitamins A and B and minerals, while roots have a high concentration of carbohydrates; about 80 percent.

Expansion of such a project may be useful to households along Kerio Valley. Many of Africa's small scale farmers will become increasingly vulnerable including those in Kerio Valley; hence strategies need to be put in place to ensure food security and prosperity for the nations of Sub-Saharan Africa. More food security problems are predicted in the future and scientists recognize that drought tolerance is one of the most desirable traits to target in breeding better crops for Africa and globally. Drought-tolerant food crops have a high potential of addressing food insecurity in Kenya. In areas where DTC have been grown, success has been recorded and food security stepped up. A programme conducted by United States Agency for International Development (USAID) under the programme USAID KAVES, has empowered many households in ASAL areas to address food insecurity through promotion of DTC such as sorghum. The organization noted that Sorghum, a drought-tolerant food crops, has boosted farm yields and incomes for smallholder farmers who mainly rely on seasonal rains, produce 75 percent of the food in Kenya (USAID, 2015).

The USAID's KAVES programme had reached more than 63,000 households with technical, marketing and business interventions for improved economic stability and food security. These are contributing to the growth of the agriculture sector in Kenya that contributes more than a quarter of the country's Gross Domestic Product (GDP) and forms a critical base in the attainment of food security. USAID KAVES aims to increase the productivity of 500,000 smallholders in the country to enhance income and food security (USAID, 2015).

The challenge of maize production in many parts of Kenya has led to seeking for alternative solutions especially growing of drought tolerant crops. Replacing maize with drought-tolerant food crops such as sorghum, millets, pigeon peas, cowpea and green grams is helping overcome the failure of rains and its damaging impact on maize in Busia County in western Kenya (ICRISAT, 2016). Currently, maize had taken over traditional crops like sorghum and

millets in Busia County. With the failure of rains in the March-July and August-December rainy seasons in 2016, who planted maize have been most affected. To promote drought-tolerant food crops like millets and sorghum, have been trained on good agricultural practices, post-harvest handling and value addition, and have been provided with quality seed of improved varieties. Capacity building of and agricultural extension workers to promote production and utilization of sorghum, finger millet and groundnuts has resulted in 62.7 tons of quality seed of the three crops being accessed by in three counties in western Kenya during the 2016/17 short rainy season.

The DTC which have a high potential in Kerio Valley include: cereals (millet and sorghum); legumes (beans, cowpeas, pigeon peas and green grams); root crops (sweet potatoes, cassava and groundnuts); and fruits (citrus, mangoes, bananas, pawpaw and watermelon). Among the cereal crops with high potential in the Ward are millet and sorghum. These crops have registered low levels of production at 16 percent for millet and four percent for sorghum due to low emphasis laid on them by households (DAO, 2007). Millet and sorghum are drought-tolerant cereal crops which do well in marginal areas with low amounts of rainfall. Millet for instance is grown mainly in low rainfall areas for subsistence and is particularly important as a food security crop because of its nutritive value and grain storage can take long periods without any pest damage (National Research Council, 1996).

A report by the Ministry of Agriculture in Keiyo North sub-county indicates that a small proportion of the drought-tolerant food crops, which have a high potential in the area are grown. These crops include millet, sorghum, cassava, cowpeas, groundnuts, green-grams, sweet potatoes, pawpaw, mangoes, oranges, tangerines and lemons (DAO, 2007). The potential of millet, sorghum and other DTC as food security crops along Kerio Valley is high. However low emphasis has been laid in the growing of these crops. This may have contributed to food insecurity in Tambach Ward.

2.5 Livestock Enterprise and food security

Livestock plays a crucial economic role in many food systems: providing income, wealth and employment; buffering price shocks; adding value to feedstuffs; providing a source of fertilizer and draught power Carvalho, P.C.F., Nabinger, C., Lemaire, G. & Genro, T.C.M, (2011). Agricultural markets face three challenges: (i) imperfect competition, due to lack of information, barriers to market entry, infrastructure constraints; (ii) externalities that create

significant costs not borne by producers; and (iii) market distortions arising from poor public policies, including subsidies and taxes that reward unsustainable practices. More specifically, agricultural markets are subject to unpredictable forces, such as the weather, and to time lags between investments in production and readiness to sell that encourage producers to be risk averse unless they are supported by safety nets. International trade has introduced opportunities but also new challenges, including an increased potential for diseases to spread. International trade has also been accompanied by a growing role for multinational private actors in making investment decisions in agricultural systems. Concentrated corporate control of agriculture has also increased in the face of uneven access to market information and technologies, undermining competition. Different livestock systems face different economic risks and opportunities in this more general context. Determining factors include: the degree of integration into international markets and urban distribution systems; the level of dependence on external inputs (such as feed); and the degree of concentration in the markets upstream and downstream from livestock producers.

Livestock constitute a very important component of the agricultural economy of developing countries. This contribution goes beyond direct food production to include multipurpose uses such as being a source of capital, accumulation of wealth and closely linked to social and cultural lives of several million-resource poor for whom animal ownership ensures varying degrees of sustainable enterprise and economic stability (FAO,1993). The livestock industry supports 12 percent of the world's population who solely depend on it for its livelihood. Most integrate livestock and crop enterprise. Mixed enterprise systems that include livestock have many advantages over crops-only agriculture. Mixed systems produce a bigger range of products, reduce risks and can be more productive than systems that rely exclusively on either crops or animals (FAO, 2009).

Livestock enterprise as a farm enterprise plays a critical role than crop enterprise in addressing food security problems. Animal products offer several advantages over crops such as: 1) meat and milk can be produced year round being less seasonal than cereals, fruits and vegetables; 2) animals particularly small ones can be slaughtered as need arises for food or income; and 3) both milk and meat can be preserved as milk curd, butter or cheese and meat by drying, curing, smoking and salting. Generally, livestock play an important role in the economy both at the farm and national level. In the provision of food, livestock at household level are: 1) liquid assets; 2) a hedge against inflation; 3) a means of reducing risks associated

with crops, when used in mixed enterprise systems; 4) a source of regular income from sales of milk and meat; 5) a source of sporadic income from the sale of live animals and their products; 6) nutritionally animals have a greater potential than crop enterprise. At the national level, increased production of livestock products will reduce the need for high-cost imports; especially food, hence curbing food insecurity and promoting development among countries, especially the developing ones (FAO, 2009).

The importance of livestock in food security cannot be underscored. The sector has been noted to play a critical role in food systems facing the emerging global food challenges. Livestock is key for smallholders as an important source of income and as labor-saving, productive assets. Livestock also contributes to nutrition, as animal sourced foods are important, especially to reduce child stunting in developing countries. Research finds that consuming a diverse array of animal sourced foods is strongly associated with child growth (IFRI, 2018). It is however suggested that for the sector to meet this objective in developing countries such as Kenya, focus should be on improving nutrition and human health, by promoting diet diversification with multiple animal sourced foods, and mitigating risk for food safety and zoonotic diseases from livestock. The smallholder livelihoods such as in Tambach ward need greater support, such as better targeted and more productive social protection policies. Further, both climate adaptation and mitigation need to be promoted, including through partnerships for climate-smart adaptation. This concept supports the study of livestock enterprise in Kerio Valley in addressing food security.

IFRI proposes that the livestock sector in all countries require policy innovations as a key role to address this concern. Policies should ensure that livestock practices improve human nutrition, mitigate climate change, and support environmental sustainability. For example, research shows that taxing emissions-intensive foods can benefit human and planetary health: it would decrease GHG emissions while avoiding 100,000 deaths by 2020 as a result of changes in dietary and weight-related risk factors. While there have been many other innovations, more research is needed. This concept supports the study of livestock enterprise and food security in Kerio Valley.

Livestock production, most of which is concentrated in ASALs, plays a major role in food security. The enterprise may be useful for commercial or subsistence purposes. For subsistence pastoralists, livestock ownership is critical in times of stress because they survive

on meat and milk alone when market prices rise. Livestock ownership is associated with greater food security. Households with acceptable food security own on average 2.3 TLUs and those with unacceptable own 1.4 TLUs. Similarly those with 'high coping' own 1.8 versus 2.5 for those using no coping (WFP, 2016)

The importance of livestock in Kenya towards food security and economy is increasingly gaining popularity. A report from the standard newspaper noted that with about 17.4 million cattle, 17 million sheep, 27.7 million goats and 2.6 million camels, Kenya has immense livestock resources. It is estimated that this sector accounts for about 10 per cent of GDP and about 42 per cent of the agricultural GDP. It however faces numerous challenges, the biggest being lack of a centralized approach to development and growth of the sector as a single entity (Standard Newspaper, July 2015).

The report further indicated that if Kenya does not improve its production, range management, value chain promotion and marketing, the country may as well prepare to use its scarce foreign exchange to meet the shortfall in local beef demand. Tambach Ward is suitable for range management and strategies need to be put in place to improve its production and enhance food security in the area. According to the United States of American International Development (USAID) in 2010, several organizations had initiated programs to support livestock enterprise in developing countries, especially in ASALs due to their low vulnerability to climatic conditions. It started a new livestock program, the Kenya Dry lands Livestock Development Program (Kenya DLDP), whose goal was to enhance trade in livestock products thereby increasing incomes and food security for more than 50, 000 pastoralist households in Kenya.

The program offers a great opportunity to small–scale producers in the Northern part of Kenya, where livestock contributes as much as 95 percent of family incomes and employs 90 percent of labour force. The organization's project has reported success in East Africa as well as on the farmer-to-farmer program in Kenya. It aspires to carry out capacity building on staff and pastoralists and work with processors, buyers and policy-makers in the other parts of Kenya (USAID, 2010).

The program specifically worked with livestock producers and processors to enhance livestock trade and marketing and add value to livestock products to increase producer incomes, improve productivity and competitiveness along the entire value chain, and support

a more favorable policy environment for the livestock industry and promoting strategies for mitigating the effect of climate change (USAID, 2010). In line with the latter, the study intends to establish the suitability of livestock production as one of the farm enterprises in dealing with food security in the ASAL areas of Tambach Ward which is faced with climatic challenges.

The main sources of livelihood for the community in Tambach Ward are: small-holder mixed enterprise, pastoralism and bee-keeping. The livestock commonly reared are cattle goats, sheep and bees. In the Ward mainly employ traditional technologies involving grazing livestock in a free-range system to rear livestock such as cattle, sheep and goats. Indigenous breeds are mainly kept due to their adaptation to semi-arid conditions though some exotic breeds of cattle and goats are also reared (JICA & GOK, 2006).

The report also showed that livestock enterprise was not well developed as indicated by the use of free range management system which contributes to poor breeding, feeding and pest and disease control, this consequently leads to poor yield and low income from this enterprise. An improvement in indigenous breeds of livestock and beekeeping may improve performance (JICA & GOK, 2006). The average milk yields of indigenous cattle breeds is three liters per day. Some of the challenges facing livestock enterprise are cattle rustling, prevalent livestock diseases, droughts and limited markets. Bee-keeping is mainly done using traditional log hives, though some modern beehives have been introduced. Tambach Ward has the potential of producing a lot of quality honey. Currently the quantity of honey produced is low, mainly due to poor harvesting techniques, lack of value addition skills and poor marketing (WVK, 2008).

2.6 Food Security Indicators

There are different indicators which can be used to describe Household Food Security (HFS). They mainly encompass process indicators and outcome indicators of food security. Process indicators are measures that reflect both supply and access to food by households; they include food availability, food accessibility, food affordability and food nutritional utilization. On the other hand, outcome indicators are measures which serve as proxies for food consumption. They fall in two categories namely direct and indirect indicators (Frankenberg, 1992)

2.6.1 Food Availability

One critical dimension of HFS is the availability or supply of food in the area for the household. Regional food shortages have a strong influence on household food availability (Frankenberg, 1992). Borton and Shoham (1991), classify the commonly used availability indicators in food monitoring systems as inputs and measures of agricultural production which include agro-meteorological data, access to natural resources, institutional development and market infrastructure and exposure to regional conflicts or its consequences such as influx of refugees. These indicators are not mutually exclusive of food access indicators and considerable overlap and interaction between the two categories may exist (Frankenberg, 1992).

Most countries monitor rainfall as part of their on–going agricultural monitoring activities and availability of this data reflect the conventional emphasis on supply determinants of food security and the possibility to determine probability of rainfall failure (Davis et al., 1991). Agro-ecological differences across regions can contribute to substantial differences in food availability; Semi- Arid agricultural zones are likely to be more prone to fluctuations in food production than humid zones (Downing, 1990). The nature and extent of the availability of common property resources by community members will have a strong influence on the part of rural households to buffer seasonal food shortages.

Information is often collected on crop harvests and remote sensing (FAO, 1990). One of the problems with this method is that it only considers figures from staple food crops but not the alternative food crops. In addition, crop production does not equal food access nor does it equal food consumption. Food balance sheets may also be used to calculate national food security (Davis, Buchana-Smith & Lambert, 1991). It assembles information over a twelve-month period based on food supplies and disposals; opening stocks, production, imports, domestic consumption, exports and closing stocks (FAO, 1990). It is used to determine the expected food deficits or surpluses, the necessary food import requirements, and food aid requirements. Some weaknesses of this indicator are that it does not give specific information about a certain area and under-estimate non-traded crops such as cassava and yams.

2.6.2 Food Accessibility

It has been realized that household food insecurity and famine conditions were occurring despite the availability of food. Researchers and development practitioners realized that food

insecurity occurred in situations where food was available but not accessible because of an erosion of people's entitlement to food (Borton & Shoham, 1991). A theory of food entitlement by Sen had a considerable influence on this shift in thinking. Entitlement involves how much food households actually have access to food from their own production, income, gathering of wild foods, community support/claims, assets and migration. Thus a number of socio-economic variables have an influence on household access to food. Food entitlement and effective demand of households are now seen as crucial to HFS (Sen, 1981).

The types of food access indicators have been identified as coping ability indicators which provide information on the capacity of the population affected by a shock or disaster to withstand its effects (Borton & Shoham, 1991). Some common coping strategies include: dispersed grazing, changes in cropping and planting practices, migration to towns in search of urban employment, increased petty commodity production, collection of wild foods, use of inter household transfers and loans, use of credit from merchants and money lenders, migration to other areas for employment, rationing of current food consumption, sale of possessions, sale of firewood and charcoal, consumption of food distributed through relief programs, sale of productive assets, breakup of the household and distress migration (Corbett, 1988; Frankenberg & Goldstein, 1991).

In general, coping strategies are pursued by households to ensure future income generating capacity (livelihood) rather than simply maintaining current levels of food consumption (Corbett, 1988; De Waal, 1988; Haddad et al., 1991). These strategies will vary by region, community, social class, ethnic group, household, gender, age and season (Chambers, 1989; Thomas et al., 1989). Assets provide coping strategies as they act as stores of value for liquidation (liquid assets), generating income (productive assets), and claims (assurance to food security). Claims include relief food supplies and farm inputs such as Drought Recovery Seed (DRS) and fertilizers. A household access to assets is often a good determinant of its vulnerability. Risk management strategies assure some level of food production by adopting responses to actual or potential food shortages during normal years to adapt rainfall variability (Longhurst, 1986; Watts, 1988).

These involve such practices as diversification of resources and enterprises, and adjustments within cropping systems, as proposed by this study. Crop centered diversification can include choice of crops with varying maturation periods, different sensitivities to environmental

fluctuations, and flexible end use of products, vertical adjustments (planting at different elevations of topography), horizontal adjustments (planting in different micro-environments) and temporal risk adjustments (staggering planting times and expansion of enterprise to marginal areas (Ibid, 1986).

Loss of management mechanisms are responses to lower than expected crop production caused by natural disasters and include non-farm activities such as sale of assets, management of stocks and reserves, seasonal migration, reciprocal obligations among households and destruction of environment. Community inequalities existing in communities call for responses along lines of wealth and access to resources (Longhurst, 1988; Tobert, 1985; Ibid, 1986).

Poorer families suffer earlier when food shortages hit than wealthier families (Frankenberg & Goldstein, 1990). The poor resort to early sale of livestock, pledge farms, incur debt, sell labor and borrow grain at higher interest rates (Watts, 1988). Coping strategy patterns fall into three major stages namely: 1) commitment of domestic resources to enable speedy recovery; 2) greater commitment of resources to meet subsistence needs; 3) destitution and distress mitigation (Corbet, 1988).

The model indicates that commitment of domestic resources is low during early stages of food shortage and high at later stages. It also describes the degree of reversibility from food shortage by households. Households who commit a lot of domestic resources during food shortage do not recover easily from impact of food shortage (low reversibility). However, low commitment of domestic resources show fast recovery from food shortages; it shows high reversibility. General coping strategies for food security are summarized in Fig. 1.

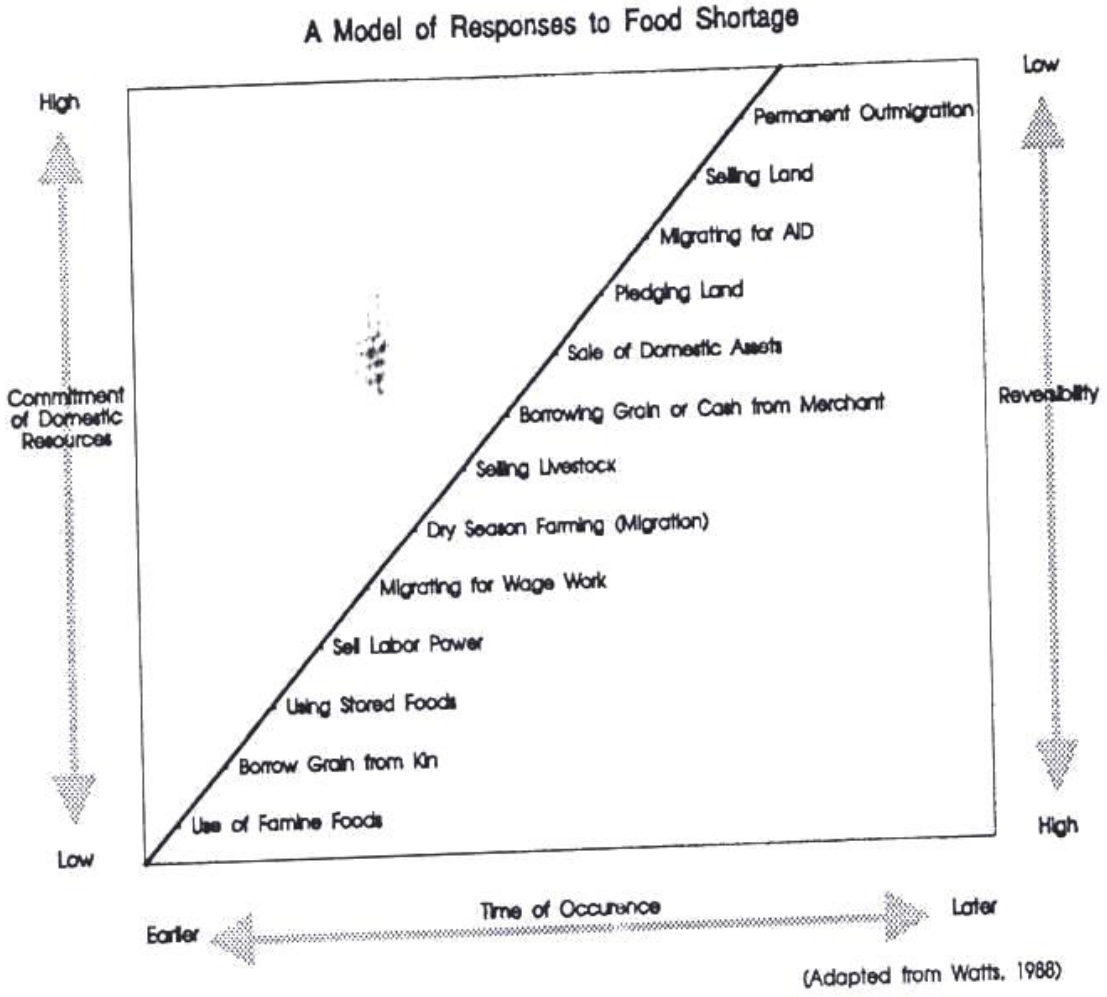

Figure 1: General Coping Strategies for food security

World Food Programme (WFP) identifies three types of indicators that can be monitored for changing coping responses. These are: early indicators, concurrent indicators and trailing indicators. Early indicators include: 1) crop failures (due to inadequate rainfall, poor access to seed and other inputs and pest damage); 2) sudden deterioration of rangeland conditions or conditions of livestock (unusual migration movement, unusual number of animal deaths, large numbers of young female animals offered for sale); 3)significant deterioration in local economic conditions (increases in price of grain, unseasonable disappearance of essential food stuffs, increased unemployment, unusual low levels of households stock; 4) significant accumulation of stock by some households due to depressed prices.

These indicators relate to both availability and access. Concurrent /stress indicators includes: 1) larger than normal able bodied family members in search for food/ work; 2) appearance in the market of unusual amounts of personal and capital goods (farm implements and

livestock); 3) unusual increases in land sales or mortgages; 4) increases in amount of people seeking credit; 5) increased dependence on wild foods; 6) reduction in number of meals; and 7) increased reliance on inter households' exchanges. These factors relate to access to food and intervention measures introduced should focus on causes to mitigate the effects. Trailing indicators come after food access has declined. Malnutrition is one of the effects of food insecurity and is normally characterized by general body weakness, high rates of morbidity and mortality among others. Trailing indicators include: 1) increased land degradation; 2) land sales; 3) consumption of stocks; and 4) permanent out migration. All these indicators are signs that the household has failed to cope with the food crises (Frankenberg & Goldstein, 1991).

2.6.3 Food Affordability

Data gathered through budget expenditure surveys can be used to determine the money spent on food by the individual or household, (Kumar, 1989). The ability of households to meet their food needs through buying will indicate their level of food security. The income obtained from enterprises and relative prices of food will determine the affordability of food. There are two methods which are generally used to determine affordability as an indicator of food security; 1) Limit consideration to food grain consumption; 2) Conversion of all food items to their calorie content (O' Brien-place & Frankenberg, 1989). Farm enterprises vary in their ability to provide households with income to buy food. Enterprises which provide sufficient or regular income to households to buy food are classified to influence food security positively. The major limitations of this indicator are: 1) Expenditure surveys tend to underestimate expenditures on food because the value of food produced at home or gathered locally is often not recorded; 2) The time and resource demands of such surveys and; 3) Data are often collected every 10 years and remote rural areas are generally under represented (Kumar, 1989).

2.6.4 Food Nutritional Utilization

Nutritional Surveys estimates the prevalence of malnutrition in a population by measuring the nutritional status of a random sample of children less than five years, weight for age and height for age is widely used in nutrition surveillance programs. In adults the 24 hour recall dietary diversity is used to determine the types of food consumed food consumed forming a balanced diet of the population. A household which consumes carbohydrates, proteins and fats is likely to be more food secure than a family who doesn't. The frequency of

consumption of these food components can be used to assess the level of household food security (Kumar, 1989).The use of this method is however associated with problems. Nutritional status is as a result of several factors in addition to food consumption and does not always correlate directly with food availability and access. Factors such as health status (disease prevalence), sanitation, mother care and level of activity of individual can influence nutritional status outcomes (O'Brien-Place & Frankenberg, 1988). To secure access to enough food to meet household food needs is necessary but not sufficient for good nutritional status. This measure is also a late indicator of food crises) due to its effects being expressed long after a food crisis (Borton &York, 1987).

2.7 Theoretical Framework

The study was guided by two theories; Social Constructivism Theory and Pragmatism Theory. They both take into account the necessity of utilizing accumulated knowledge by people to solve their problems. Social Constructivism theory advocates that society is perceived as part of human world, made by men, inhabited by men and in turn making men in an ongoing historical process (Berger & Luck man, 1968).

The process of acquiring knowledge and utilization to solve human problems includes the accumulation, preservation and dissemination of agricultural knowledge for production through experience arising from interaction with environment. Appropriate choice of farm enterprises to enhance food security falls under accumulation of knowledge; formal or non-formal on how environmental conditions have influenced their success over time. The Social Constructivism theory is made up of certain elements; one of which is cultural interface. In cultural interface local people are seen to live and learn the place that conditions their lives, the place that shapes their future and mainly where they are active agents in their own lives-where they make decisions about their livelihoods (Nakata, 1997). The ability to appropriately choose farm enterprises by households based on the prevailing ecological and technological conditions as advocated by this study is supported by Social constructivism theory. This may help households to deal with food insecurity in Tambach Ward.

Pragmatism is another theory which explains the experience of people and how they react to the environment through learned 'actions'. The theory of Pragmatism as advocated by Dewey and other positivist thinkers such as Ferreira and Hoch is very useful in guiding concrete action in solving social and environmental problems through learned technologies passed

over generations (Hoch, 1984). The application of this knowledge is based on the need by households to understand the agro-ecological conditions controlling agricultural activities and orient their actions to meet their food needs. The functional knowledge by the model on the success rates of farm enterprises over the years forms a basis for the selection of the most suitable enterprises to solve their food problems.

2.8 Conceptual Framework

This section discusses the relationship between independent and dependent variables in the study that influence the level of food security in Tambach Ward. The conceptualization of the study is meant to realize Social Constructivism and pragmatism theories. In the study, it was postulated that the independent variables were the major farm enterprises in Tambach Ward. These were maize enterprise, drought-tolerant food crops enterprise, and livestock enterprise that influence the level of food security. Collection of data for each enterprise as relates to food security was used to determine the relationship between farm enterprises and food security among households in Tambach Ward.

The dependent variables were; food availability, food accessibility, food affordability and food nutritional utilization. Food availability was measured by considering the amount of food produced by households from each enterprise and whether the period food was adequate for households in the year. The amount of food was measured in 90kg bags for crops and kilograms for livestock products. Food accessibility was determined by considering the frequency with which households obtained the food they required in the local markets. Where food was more accessible, households were more food secure than when food was scarce in the market. Food affordability was determined by establishing the ability of households to buy food as determined by income from farm enterprises. This was determined by prices of food in the market and household income. Cheap food and high household income made households more food secure and vice versa. Food nutritional utilization described the ability of food produced from major enterprises to meet nutritional needs of households for healthy living. A 24-hour dietary recall was used to establish from households whether a balanced diet was consumed in the last 24-hours of each day. An overall food security index was used to establish the contribution of each enterprise towards food security in the Ward.

For each enterprise, the influence on food security was determined by considering the specific food security parameter and overall contributions based on the weight of all

parameters for measuring food security. Intervening variables were controlled in the study to reduce their effects on dependent variables and to avoid confounding the results (Oso & Onen, 2008). The intervening variables in the study included household and institutional factors. Household factors encompass sale of domestic assets, pledging of land and income from off farm activities. These factors were controlled through randomization of households in the study area. The use of purposive, stratified and systematic sampling techniques ensured that representative samples that were essentially similar in all the relevant characteristics that influenced the dependent variable were obtained. Institutional factors which included relief food supplies and borrowing loans to buy food were controlled by sampling a homogenous population along Kerio Valley who all benefit from relief food supplies and have similar socio-economic status. This was achieved through randomization of the households to reduce the chances of sampling with different socio-economic conditions. The relationship between dependent and independent variables is shown in Figure 2.

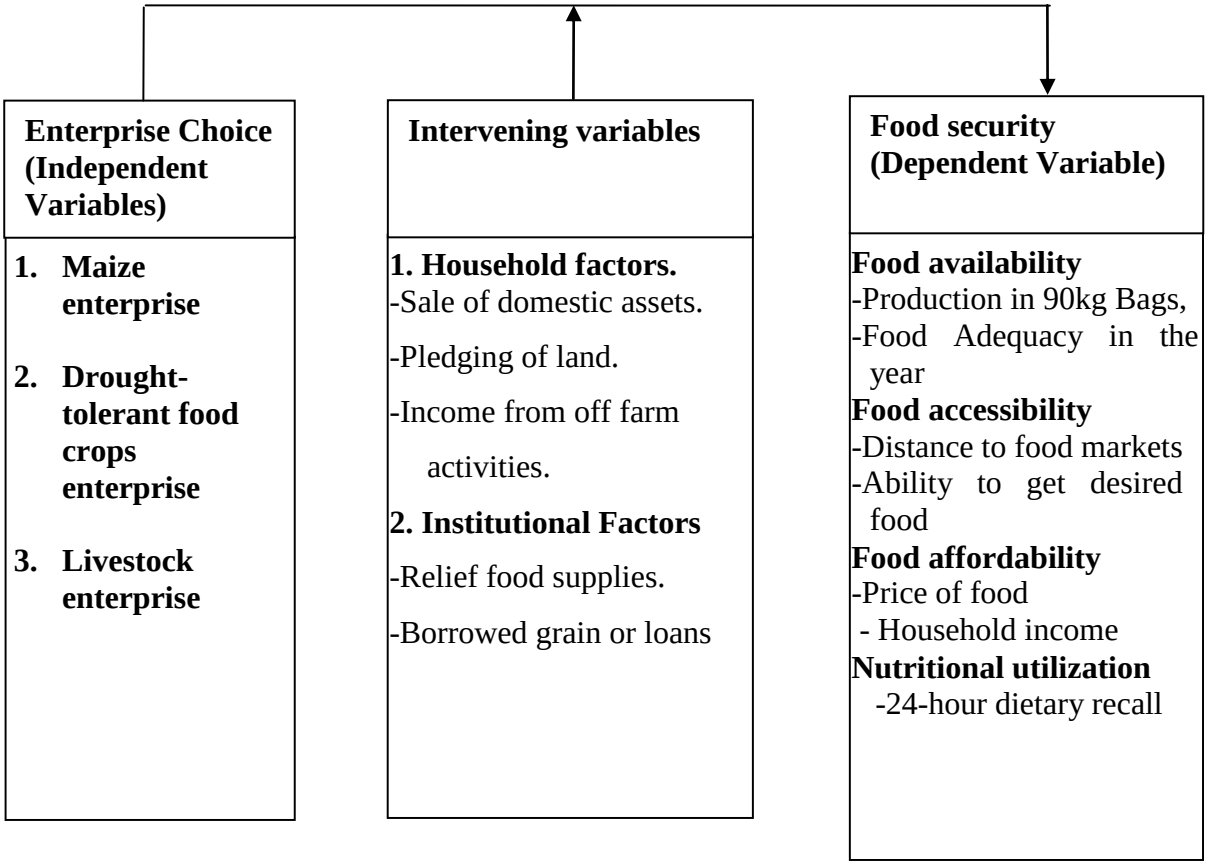

Figure 2: Conceptual Framework Showing the relationship between Choice of Farm Enterprises and Food Security.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes how the research was carried out. It describes research design, study location, target population, sampling procedure and sample size, instrumentation, data collection and data analysis.

3.2 Research Design

Survey research design was used to collect data from farm households on the relationship between choices of farm enterprises on food security in Tambach Ward. The purpose of survey research design is to explore and describe the characteristics of a population under study (Kathuri & Pals, 1993). Survey research design is used in preliminary and exploratory studies (Luck & Ruben, 1992) to allow the researchers to gather information, summarize, present and interpret for the purpose of clarification (Orodho, 2002). In this study, the level of contribution of each of the farm enterprises towards food security in Kerio valley was described and the factors influencing the choice of farm enterprises identified. The design involves collection of data in a section of a population at one point in time (Fraenkel & Wallen, 2000).

3.3 The Study Area

The study was carried out in Tambach Ward of Keiyo North Sub County. The Sub County forms one of the four Sub Counties making up Elgeyo Marakwet County. The Sub County covers an area of 541 km^2, with a population of 73,715 people, according to Kenya National Bureau of Statistics (2009). The Sub-county comprises of three Wards namely Tambach, Kamariny and Kapchemutwo. The map of Keiyo Sub Counties; Keiyo North and Keiyo South, showing Tambach Ward is shown in Appendix B. Tambach Ward is made up of four locations and 15 Sub locations and covers an area of 331 $km^{2.}$. There are 5,160 households with a total population of 22,719 and a population density of 69 people per kilometer square (KNBS, 2017). Keiyo North Sub county is divided into three agro-ecological zones; Keiyo highlands, Keiyo escarpment and Kerio Valley. The study was carried out in Kerio Valley of Tambach Ward leaving out the escarpment and the highlands due to their low prevalence to food insecurity. The four locations making up Tambach Ward are; Kokwao, Keu, Kamogich and Kiptuilong. The latter three have various proportions of their parts lying along the Valley as shown in Table 1.

Table 1: Proportions of Locations in Tambach Ward along Kerio Valley

Location	Proportion along the Valley (%)
Keu	100
Kamogich	25
Kiptuilong	25

Source: Keiyo North Sub County Agriculture Office, 2017.

Kerio Valley is characterized by an altitude of between 1000-1200 meters above the sea level, and rainfall ranging between 400-850 millimeters per annum; which is highly erratic and insufficient. The soils from ashes of old volcanic and basement rocks, are of moderate fertility and suitable for cultivation due to their richness in organic matter. These soils are, however threatened by erosion due to sparse vegetation, high and torrential run offs and overgrazing (MoA, 2007).

3.4 Target Population

The total population in the three locations was 16,790 people. There were 2,786 households (KNBS, 2009). Details of population and number of households per location are shown in Table 2. The target population consisted of households practicing farming activities in three locations of the Ward namely Keu, Kamogich and Kiptuilong who are predominantly Keiyo sub tribe from Kalenjin tribe.

Table 2: Population and Number of Households in the Study Area

Location	Number of Households	Population
Keu	1,000	2,154
Kamogich	925	7,967
Kiptuilong	861	6,669
Total	2,786	16,790

Source: Kenya National Bureau of Statistics, 2016.

3.5 Sampling Procedure and Sample Size

This study employed purposive, stratified and systematic sampling techniques. Purposive sampling was used to select the locations under study; Keu, Kamogich and Kiptuilong which had homogenous characteristics. These locations had high prevalence of food insecurity unlike those lying along the escarpment or the highlands. Stratified sampling was used to

select sub-groups of population based on the proportions per location to ensure equitable representation of each stratum. A list of all households in each sub location was obtained from location Agricultural office to form the sampling frame. Systematic sampling was used to select proportionate number of respondents from each sub location to give proportionate sample sizes per location. The sample was obtained by employing a formula for determining appropriate sample size of randomly chosen respondents from a given finite population of N cases and sample proportion P. P is plus or minus 0.5 of the population proportion with a 95 % level of confidence (Kathuri & Pals, 1993). The formula is expressed as:-

$$S = \frac{X^2NP(1-P)}{d^2(N-1) + X^2(1-P)}$$

Where;

S= Sample size

N= Population size (16,790)

P= Population Proportion, assumed to be 0.50

d= Degree of accuracy whose value is 0.05

X^2= Table value of Chi square for 1 degree of freedom which is 3.841 at 0.95 confidence level.

The final sample consisted of 120 household heads selected from 2,786 households in the three locations in the Ward. A minimum sample size of 100 is considered appropriate for social science studies (Kathuri & Pals, 1993). The extra number of 20 respondents was meant to cater for dropouts and non-respondents during the study. These proportionate samples are based on the population and proportion of each location found in Kerio Valley. Agricultural extension officers guided and provided relevant information in the study. Specific sample sizes for the selected locations are shown in Table 3.

Table 3: Number of Households and Proportionate Sample Sizes per Location

Location	Total Number of Households	Proportion of Households	No. of Households
Keu	1,000	0.36	43
Kamogich	925	0.33	40
Kiptuilong	861	0.31	37
Total	**2,786**	**1.00**	**120**

3.6 Instrumentation

This section gives details of instruments which were used in the study. It discusses instruments for data collection, validity and reliability. The study used interview schedule to collect data from household heads. A structured interview schedule (Appendix A) was administered by the researcher to collect information from house hold heads. The data collected was on farm enterprises practiced, factors determining farm enterprise choice, Status of growing drought-tolerant food crops and household food security as relates to food availability, food accessibility, food affordability and food nutritional utilization.

The instrument was appropriate in collecting information from household heads with low literacy levels as it allows for clarification of any ambiguity and does not discriminate against the less articulate respondents (Leung, 2001). The instrument was easy to administer, score and responses were consistent and readily analyzed (Ary, Jacobs & Razaviech, 1979). The interview schedule consisted of four sections: Section A dealt with respondent's Bio data and collected interval and nominal data; Section B was on identification of farm enterprises and factors determining their choice giving interval and categorical data; Section C covered household food security (food availability, accessibility, affordability and nutritional utilization) for each of the major farm enterprises (maize crop enterprise, drought-tolerant food crops enterprise and livestock enterprise),giving ordinal data; Section D, on institutional factors gave categorical data.

3.6.1 Validity

Validity is the extent to which research results can be accurately interpreted and generalized to other populations. It is the extent to which research instruments measure what they are intended to measure (Oso & Onen, 2005). To establish validity, the instruments were reviewed before administration by supervisors and peers in the Department of Agricultural Education and Extension of Egerton University to improve content and face validity. They were evaluated according to the relevance of each item in the instrument to the objectives. Inspection on suitability and complexity of questions was also done.

3.6.2 Reliability

The instruments were pre-tested to ensure consistency. The interview schedule was administered under a pilot test in Cheptebo location in Chepkorio Ward. This area has similar subjects and agro-ecological conditions like in the study area. Twenty household heads were selected randomly for this pilot test. This number is in conformity with the small number in a pre-test recommended at 10 percent of the entire sample (Orodho, 2003).

Piloting the instrument assisted to determine the appropriateness of the instrument and improvement based on its reliability co-efficient. Cronbach alpha was used to test reliability and a reliability co-efficient of 0.82 was obtained which is above the recommended 0.7. Data from interview schedule were grouped under broad themes and converted into frequency counts. Data was analyzed at 0.05 level of significance. The value α=0.05 was chosen because the sample size was adopted from figures calculated on the basis of 95% level of confidence.

3.7 Data Collection

The researcher obtained a letter from the Graduate School of Egerton University which was presented to the National Commission for Science, Technology and Innovation (NACOSTI) in the Ministry of Education to obtain a research permit. On obtaining authority, permission was sought from the Keiyo North Sub County Agriculture Office to conduct research in Tambach Ward. A visit to the Wardal Agricultural Office to obtain a list of for each location and permission to work with location personnel was arranged. The researcher visited chiefs for the different locations; Keu, Kamogich and Kiptuilong to obtain information about their locations and guidance on data collection from households. Agricultural extension officers in the locations of study guided in the sampling of household heads. This assisted in the

administration of the instrument. Data was collected using structured interview schedule from 120 respondents sampled from the target population of 2,786 household heads. Interview schedule was appropriate because most household heads had low literacy levels and needed interpretation of the items in the instrument. The researcher collected data from the three locations as guided by the chiefs and agricultural extension officers.

3.8 Data Analysis

Data from interview schedules was organized, collated and coded according to study objectives and variables. Summarized data was entered into the computer for analysis using the Statistical Package for Social Sciences (SPSS). Data was analyzed using descriptive and inferential statistics. Descriptive statistics used were frequencies and percentages to describe the factors influencing choice of farm enterprises and the level of contribution of each enterprise towards food security. Inferential statistics used were Pearson's Product Moment Correlation and Multiple Regression Analysis. Hypotheses 1, 2 and 3 were tested using Multiple Regression. The hypotheses were tested at 0.5 level of significance. The Comparison of indices obtained for each farm enterprise was used to determine their relationship with food security. A summary is provided in Table 4.

Table 4: Summary of Data Analysis

Hypothesis	Independent variables	Dependent variables	Statistical procedures and Tests
HO_1: There is no statistically significant relationship between choice of maize enterprise and food security among households living along Kerio Valley, Tambach Ward.	Maize enterprise.	Level of food security ● Availability ● Accessibility ● Affordability ● Nutritional utilization.	• Pearson's Product Moment Correlation • ANOVA • Multiple Regression
HO_2: There is no statistically significant relationship between choice of drought-tolerant food crops enterprise and food security among households living along Kerio Valley, Tambach Ward.	Drought-tolerant food crops enterprise.	Level of food security ● Availability ● Accessibility ● Affordability ● Nutritional utilization.	• Pearson's Product Moment Correlation • ANOVA • Multiple Regression
HO_3: There is no statistically significant relationship between choice of livestock enterprise and food security among households living along Kerio Valley, Tambach Ward.	Livestock enterprise.	Level of food security. ● Availability ● Accessibility ● Affordability ● Nutritional utilization.	• Pearson's Product Moment Correlation • ANOVA • Multiple Regression

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CHAPTER FOUR
RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the research findings of the study. The data were analyzed using SPSS software and was based on variables and objectives of the study. It discusses both descriptive and inferential statistics on the relationship between farm enterprise choice and food security in Tambach Ward along Kerio Valley. The results were presented to capture the background information of the respondents and study objectives.

4.2 Background Information of respondents

The respondent's characteristics were described in this section based on the study. These include; gender, age, level of education, location and sub location of residence, and size of land.

4.2.1 Distribution of respondents in Locations of study

The respondents involved in the study were proportionately drawn from the three locations of the study based on their respective population. The findings showed that 37.8% of the respondents were drawn from Kamogich location, 31.5% were from Kiptuilong location and 30.6% from Keu location. The proportion of respondents is summarized in Table 5.

Table 5: Proportions of respondents in Location of study

Location	Frequency	Percent	Cumulative Percent
Keu	34	30.6	30.6
Kamogich	42	37.8	68.5
Kiptuilong	35	31.5	100.0
Total	**111**	**100.0**	

4.2.2 Gender of Respondents

The findings indicate that there was gender disparity in the distribution of respondents involved in the study. Majority of the respondents 82 (73.9%) were male and a few 29 (26.1%) were female. This implies that most of the household heads that determine choice of farm enterprises are male and they play a great role in ensuring that the family is food secure at any given time. The proportion of gender involved in the study is summarized in Figure 3.

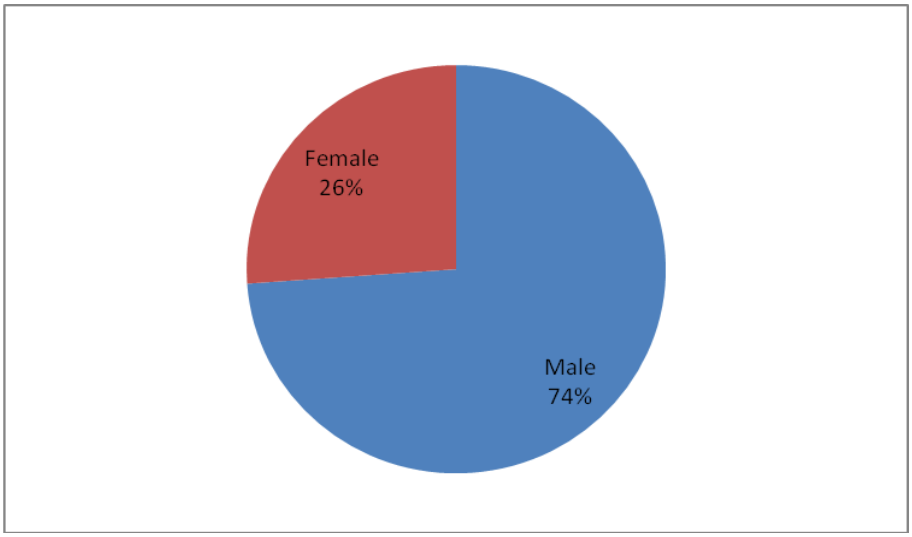

Figure 3: Gender of respondents

4.2.3 Age Distribution of Respondents

The proportion on the age of respondents showed variations. From the findings of the study, 48 (43.2%) of respondents were aged between 21 to 30 years, 26 (23.4%) were aged between 31 and 40 years, 16 (14.4%) were aged between 41 and 50 years, 15 (13.5%) were above 50 years of age and the least 6 (5.4%) were below 20 years of age. The findings show that most of the respondents are between the age of 21 and 40 years. This indicates that households majorly comprise mostly of youth and middle age adults. The productive age engaged in enterprise activities were represented in the study. The age distribution of the respondents is summarized in Figure 4.

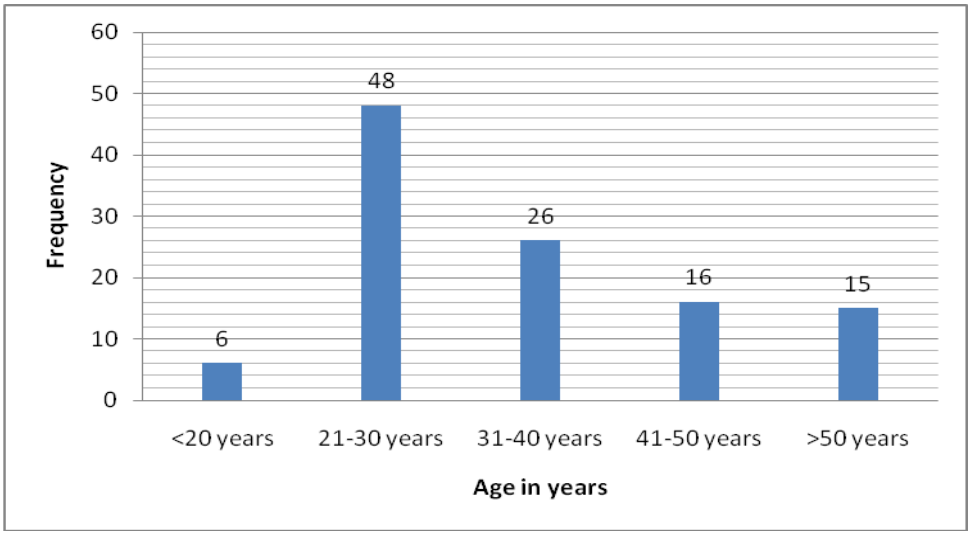

Figure 4: Age distribution of respondents

4.2.4Education level of respondents

The level of education of respondents was established to determine literacy and awareness level that existed between the households involved in the study. The findings on education level showed that 41(36.9%) had secondary education, 40 (36%) had primary education, 28 (25.2%) had college/university education and the least two (1.8%) had no formal education. The finding indicate that most of the respondents were literate with 62.2 % had at least secondary level of education. Balakrishnan (2001) indicated that there is an important link between education level and possession of appropriate information. In Agriculture, education level of is important in sourcing technical information and implementing the advice from agricultural extension services thus enhancing food security by choosing farm enterprises that have high productivity and sustainable in food security.

The education level of the respondents is summarized in Figure 5.

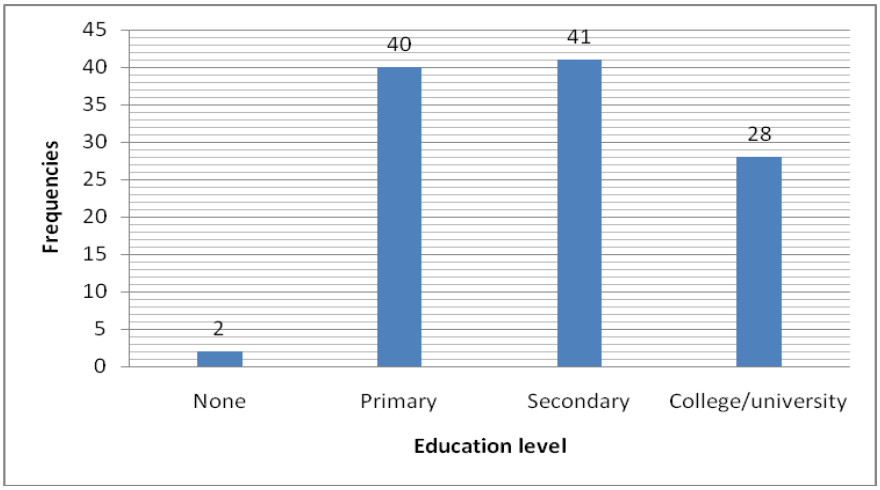

Figure 5: Education level of the respondents

4.2.5 Size of land in acres

The size of land owned by respondents was determined. Size of land was used in the study because it portrays the variation in acres that may exist between among households living in the area of study. From the findings, 57(51.4%) of households owned between 1.1 to 2.5 acres, 29 (26.1%) owned between 2.6 to 5 acres and 13(11.7%) owned below one acre while 12(10.8%) owned above 5.1 acres of land. This indicates that most households own less than 2.5 acres. Farm size influences the types and number of enterprises practiced by households. The smaller the farm size, the more it limits the choice of farm enterprises while the bigger

the farm size, the greater the choice of farm enterprises. The size of land among the respondents is summarized in Figure 6.

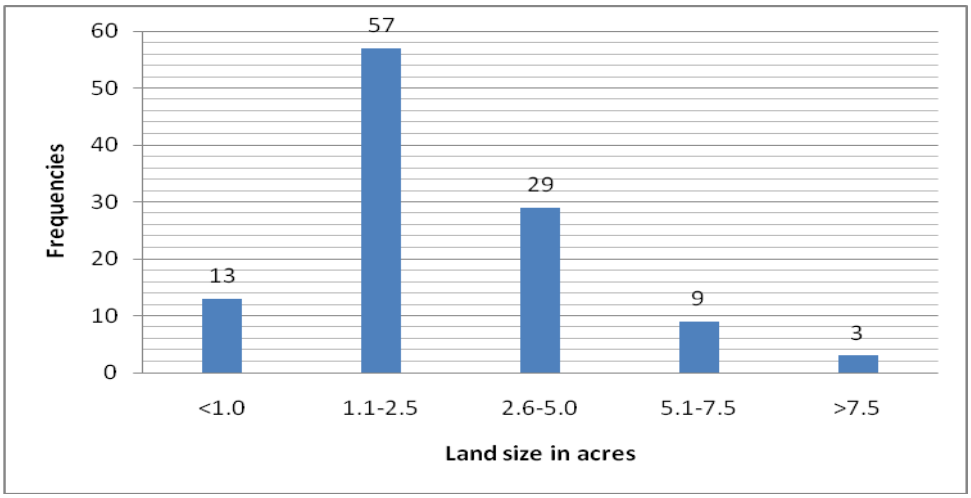

Figure 6: Land size in acres

4.3 Relationship between choice of Maize enterprise and food security

The first research objective was to establish the relationship between choice of maize enterprise and food security in Tambach Ward and was translated into hypothesis: ”There is no statistically significant relationship between choice of maize enterprise and food security among households living along Kerio Valley.”This was achieved through the use of both descriptive and inferential statistics. The descriptive part comprised of frequency, percentages, mean and standard deviation. The inferential statistics comprised of Pearson Product Moment Correlation and Multiple Regression. Food security was determined using the food security indicators namely; food availability, food accessibility, food affordability and food nutritional utilization. The findings on how the maize enterprise choice influences food security are presented in the following sections.

4.3.1 Correlation on Choice of Maize Enterprise and Food Security indicators

Pearson Correlation Coefficient was used to determine the degree of relationship between choice of maize enterprise and food security indicators. There was positive relationship between choice of maize enterprise and food availability [r=.243, p<.05]. This indicates that an increase in choice of maize enterprise contributes to more food being available to households. The low correlation value of (.243) implies maize enterprise provided a small amount of food during the year. This may be attributed to low production, occasioned by maize failure as a result of low and erratic rainfall in Kerio Valley.

There was positive significant correlation between choice of maize enterprise and food accessibility [r=.319, p<.01]. This indicates that an increase in choice of maize enterprise makes households to obtain more food in markets. The low (r=.319) implies that maize from local market supply is not always adequate to supplement the low production from their farms. There was negative correlation between choice of maize enterprise and food affordability [r=.077, p>.05] as well as nutritional utilization [r=.081, p>.05]. This indicates that an increase in choice of maize enterprise does not influence the ability of households to obtain adequate income to buy food of their choice. It also suggests that maize alone does not meet the nutritional requirements of households but require food from other enterprises. The relationship between choice of maize enterprise and food security indicators are shown in Table 6.

Table 6: Correlation on Choice of Maize Enterprise and Food Security indicators

	Maize enterprise		Availability	Accessibility	Affordability	Utilization
Maize enterprise	Pearson Correlation	1				
	Sig. (2-tailed)					
Availability	Pearson Correlation	.243*	1			
	Sig. (2-tailed)	.011				
Accessibility	Pearson Correlation	.319**	.420**	1		
	Sig. (2-tailed)	.001	.000			
Affordability	Pearson Correlation	.077	.104	.184	1	
	Sig. (2-tailed)	.429	.286	.057		
Nutritional Utilization	Pearson Correlation	.081	.169	.294**	.351**	1
	Sig. (2-tailed)	.404	.081	.002	.000	

*. Correlation is significant at the 0.05 level (2-tailed).

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

N=109

4.3.2 Overall Correlation on choice of Maize Enterprise and Food Security

The food security indicators were computed to form an index of food security. The findings are presented in table 4.4.

Table 7: Overall Correlation on choice of Maize Enterprise and Food Security

		Maize enterprise	Food security
Maize enterprise	Pearson Correlation	1	.195*
	Sig. (2-tailed)		.043
Food security		.195*	1
	Sig. (2-tailed)	.043	

*. Correlation is significant at the 0.05 level (2-tailed).

N=109

From table 8, the findings revealed that there was a significant positive relationship between choice of maize enterprise and food security [r=.195, p<.05]. This indicates that an increase in choice of maize enterprise contributes to more food security among the households in Tambach Ward. The low correlation value suggests that maize enterprise experiences crop failure due to low amount of rainfall received along Kerio Valley. Households have continually grown maize despite crop failure due to their feeding habits; maize is regarded as a staple food crop more than other food crops.

4.3.3 Hypothesis test of Choice of Maize Enterprise

The hypothesis was stated as follows;

HO_1: There is no statistically significant relationship between choice of maize enterprise on food security in Tambach Ward of Kerio Valley.

The findings showed that $\beta 2 = 0.034$ ($p > 0.05$). This indicates that for each unit increase in choice of maize enterprise, there is no significant unit increase (0.034) in food security which indicates that we fail to reject the null hypothesis which stated that "There is no statistically significant relationship between choice of maize enterprise on food security in Tambach Ward of Kerio Valley". Also, the influence of choice of maize enterprise is shown by the t-test value (t=1.4) which implies that the effect of maize enterprise surpasses that of the error by over 1.4 times.

4.4 Relationship between choice of Drought-tolerant food crops enterprise and food security

The second objective was to establish the relationship between choice of drought tolerant food crop enterprise and food security and was translated into hypothesis: "There is no

statistically significant relationship between choice of drought-tolerant food crops enterprise and food security among households living along Kerio Valley, Tambach Ward". This was achieved through the use of both descriptive and inferential statistics. Food security was determined using the food security indicators such as; food availability, food accessibility, food affordability and food nutritional utilization.

4.4.1 Correlation on choice of Drought-tolerant food crops Enterprise and Food Security indicators

The findings revealed that there was significant positive relationship between choice of drought-tolerant food crops enterprise and food availability [r=.624, p<.01]. This indicates that an increase in choice of drought-tolerant food crops enterprise contributes to more food availability to households. The positive relationship between choice of drought-tolerant food crops and food availability was attributed to higher tolerance of drought-tolerant food crops than maize. Also a positive correlation existed between drought-tolerant food crops enterprise and food security accessibility [r=.618, p<.01]. This indicates that an increase in choice of drought-tolerant food crops enterprise increases the supply of food in the market for households. The positive correlation existed since households sell the produce to buy other food crops including maize.

Moreover, a positive relationship existed between choice of drought-tolerant food crops enterprise and food affordability [r=.449, p<.01]. This implies that an increase in choice of drought-tolerant food crops enterprise enabled to earn income that led to improved capacity to buy food and hence improving food security. Finally, a positive correlation existed between choice of drought-tolerant food crops enterprise and food nutritional utilization [r=.460, p<.01]. This imply that the more households chose drought-tolerant food crops enterprise, the higher the chances of being in a position to obtain food of sound nutritional utilization.

A summary of choice of drought-tolerant food crops enterprise and food security indicators is as shown in Table 8

Table 8: Correlation on choice of Drought-tolerant food crops Enterprise and Food Security indicators

		Drought resistance food crop	Availability	Accessibility	Affordability	Utilization
Drought resistance food crop	Pearson Correlation	1				
	Sig. (2-tailed)					
Availability	Pearson Correlation	.624**	1			
	Sig. (2-tailed)	.000				
Accessibility	Pearson Correlation	.618**	.580**	1		
	Sig. (2-tailed)	.000	.000			
Affordability	Pearson Correlation	.449**	.378**	.496**	1	
	Sig. (2-tailed)	.000	.000	.000		
Nutritional Utilization	Pearson Correlation	.460**	.255**	.449**	.456**	1
	Sig. (2-tailed)	.000	.008	.000	.000	

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

N=109

4.4.2 Overall Correlation on choice of Drought-tolerant food crops enterprise and Food Security

The food security indicators were computed to form an index of food security and correlated to drought-tolerant food crops enterprise. The summary of choice of Drought-tolerant food crops enterprise is indicated in Table 9.

Table 9: Correlation on choice of Drought-tolerant food crops Enterprise and Food Security

		DTC enterprise	Food security
DTC enterprise	Pearson Correlation	1	.412**
	Sig. (2-tailed)		.000
Food security	Pearson Correlation	.412**	1
	Sig. (2-tailed)	.000	

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

N=109

From table 9, the findings revealed that there was positive relationship between choice of drought-tolerant food crops enterprise and food security [r=.412, p<.01]. This indicates that an increase in choice of drought-tolerant food crops enterprise contributes to more food security among the households in Tambach Ward. The overall food security index for drought-tolerant food crops enterprise was higher as compared to maize enterprise. This indicates that the drought-tolerant food crops enterprise that withstands adverse environmental conditions than maize crop enterprise

4.4.3 Hypothesis test of Choice of Drought-tolerant food crops Enterprise

Reject the null hypothesis which stated that "there is no statistically significant relationship between of choice of drought-tolerant food crops enterprise and food security in Tambach Ward of Kerio Valley".

HO_2: There is no statistically significant relationship between choice of drought-tolerant food crops enterprise and food security among households living along Kerio Valley, Tambach Ward.

The findings showed that $\beta 1 = 0.202$ ($p < 0.05$). This indicates that for each unit increase in choice of drought-tolerant food crops enterprise, there is up to 0.202 units increase in food security. This implies that we reject the null hypothesis which stated that "there is no statistically significant relationship of choice of drought-tolerant food crops enterprise on food security in Tambach Ward of Kerio Valley" and accept the alternative which states that "there is a statistically significant relationship between choice of drought-tolerant food crops enterprise and food security along Kerio Valley, Tambach Ward. The effect of drought-

tolerant food crops enterprise is stated by the t-test value (t= 3.82) which indicates that the effect of choice of drought-tolerant food crops enterprise is about 3.8 times that of the error associated with it.

4.5 Relationship between choice of livestock enterprise and food security

The third research objective was to establish the relationship between choice of livestock enterprise and food security and was translated into hypothesis: "There is no statistically significant relationship between choice of livestock enterprise and food security among households living along Kerio Valley, Tambach Ward".

This was achieved through the use inferential statistics. Food security was determined using the food the security indicators; food availability, food accessibility, food affordability and

4.5.1 Correlation on food nutritional utilization. the choice of Livestock Enterprise and Food Security indicators

Pearson Correlation Coefficient was used to determine relationship of livestock enterprise on food security. The summary of correlation of livestock enterprise and food security indicators is shown in Table 10

Table 10: Relationship between choice of Livestock Enterprise and Food Security

		Livestock Enterprise	Available	Accessed	Affordable	Utilization
Livestock enterprise	Pearson Correlation	1				
	Sig. (2-tailed)					
Availability	Pearson Correlation	.464**	1			
	Sig. (2-tailed)	.000				
Accessibility	Pearson Correlation	.581**	.330**	1		
	Sig. (2-tailed)	.000	.001			
Affordability	Pearson Correlation	.563**	.206*	.322**	1	
	Sig. (2-tailed)	.000	.033	.001		
Nutritional Utilization	Pearson Correlation	.322**	.070	.314**	.248**	1
	Sig. (2-tailed)	.001	.473	.001	.010	

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

*Correlation is significant at the 0.05 level (2-tailed).

N=109

From table 10, the findings revealed that there was a positive relationship between choice of livestock enterprise and food availability [r=.464, p<.01]. This indicates that an increase in

choice of livestock enterprise contributed to more food being available to households. This was attributed to livestock having the ability to survive longer than crops during dry spells and drought. A positive correlation existed between choice of livestock enterprise and food security accessibility [r=.581, p<.01]. This indicated that an increase in choice of livestock enterprise increased accessibility of livestock products in the market. Households keep a variety of livestock such as sheep, goats and cattle that have higher chances of survival than crops which increase supply of products for households.

Furthermore a positive relationship existed between choice of livestock enterprise and food affordability [r=.563, p<.01]. This implies that an increase in choice of livestock enterprise provided households with more income through sale of livestock and products to buy alternative food of their choice. Finally, a positive correlation existed between choice of livestock enterprise and food nutritional utilization [r=.322, p<.01]. This implied that the more chose livestock enterprise the higher the chances of being in a position to have food of sound nutritional utilization. The enterprise provides food products such as meat, milk and eggs. Milk and eggs are considered as whole food.

4.5.2 Overall Correlation on choice of Livestock Enterprise and Food Security

The food security indicators were computed to form a food security index. The summary on correlation of choice of livestock enterprise and food security is summarized in Table 11.

Table 11: Correlation on Choice of Livestock Enterprise and Food Security

		Livestock enterprise	**Food security**
Livestock enterprise	Pearson Correlation	1	
	Sig. (2-tailed)		
Food security	Pearson Correlation	.504**	1
	Sig. (2-tailed)	.000	

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

N=109

From table 12, There was a positive relationship between choice of livestock enterprise and food security [r=.504, p<.01]. This indicated that an increase in choice of livestock enterprise

contributes to higher food security among the households in Tambach Ward. The overall food security index for livestock was the highest among the other enterprises under study. This suggests that livestock enterprise has the ability to withstand adverse environmental conditions than crops hence higher capacity to provide food security to households in Tambach Ward.

4.5.3 Hypothesis test on Choice of Livestock Enterprise

The hypothesis was stated as follows;

HO_3: There is no statistically significant relationship between choice of livestock enterprise and food security along Kerio Valley, Tambach Ward.

The findings showed that $\beta 3 = 0.289$ ($p < 0.05$). This indicates that for each unit increase in choice of livestock enterprise, there was up to 0.289 units increase in food security. This implied that we reject the null hypothesis which stated that "there is no statistically significant relationship between choice of livestock enterprise and food security along Kerio Valley, Tambach Ward" and accept the alternative which states "there is a statistically significant relationship between choice of livestock enterprise and food security along Kerio Valley, Tambach Ward". The effect of livestock enterprise is stated by the t-test value (t= 5.18) which indicates that the effect of choice of livestock enterprise is about 5.2 times that of the error associated with it.

4.5.4 Overall Multiple Regressions on Choice of Farm Enterprises

The Multiple Regression was used to establish the prediction of food security from the choice of farm enterprises under study. Multiple Regression model summaries were developed to show the prediction of enterprises on food security. The summary on Multiple Regression model is shown in Table 13.

Table 13: Model Summary

Model	**R**	**$(R)^2$**	**Adjusted $(R)^2$**	**Std. Error of the Estimate**	**Change Statistics**				
					R Square Change	F Change	df1	df2	Sig. F Change
1	**.601[a]**	**.362**	**.342**	**.19450**	**.362**	**18.875**	**3**	**100**	**.000**

a. Predictors: (Constant), Livestock, Maize, Drought-tolerant food crops Enterprises

From Table 13, R^2 represents the values of multiple correlation coefficients between the predictors used in the model and choice of of farm enterprise. R^2 represented the measure of variability in choice of farm enterprises that is accounted for by the predictors; independent variables. From the model, (R^2 = .362) shows that all the predictors accounted for 36.2% variation in choice of farm enterprise. Therefore, the predictors used in the Multiple Regression models have captured the variation in the food security. The adjusted R^2 gave the idea of how well the model generalizes the prediction of food security by the independent variables. The value of adjusted R^2 was .342, showing that the prediction of food security account for approximately 34.2% less variance. The change statistics were used to test whether the change in adjusted R^2 is significant using the F ratio. The model caused adjusted R^2 to change from zero to .362 and this change gave rise to an F ratio of 18.88, which is significant at a probability of .05.

4.6 Analysis of Variance

The analysis of variance was used to test whether the Multiple Regression models could significantly fit in predicting the outcome than using the mean. The F- ratio represents the ratio of improvement in prediction that results from fitting the model, relative to the inaccuracy that exists in the model. The F- ratio was 18.88 which is likely to happen by chance and was significant at (P<.05). The model significantly improved the ability of enterprise enterprises to predict food security. The summary on analysis of variance is shown in Table 14.

Table 14:Analysis of Variance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.142	3	.714	18.875	.000[b]
	Residual	3.783	100	.038		
	Total	**5.925**	**103**			

a. Dependent Variable: Food security

b. Predictors: (Constant), Livestock, Maize, Drought-tolerant food crops

Table 14, shows the estimates of β values and gives an individual contribution of each predictor to the model. The β value explains the farm enterprise prediction with each predictor. The positive β values indicate the positive relationship that exists between the

predictors and the outcome. The β value for maize, drought-tolerant food crops and livestock enterprise had a positive coefficient thus positive relationship with food security as summarized in the model below.

The model was then specified as:

Food security= .769 +.202Dr +.034Mz + .289Lv + α.....Eqn 1.0

Where:

Dr = Drought-tolerant food crops

Mz = Maize

Lv = Livestock

The t-test was used as a measure to identify whether the predictors were making a significant contribution to the model. When the t-test associated with b-values is significant, and then the predictor is making a significant contribution to the model. The larger the t-test value, the greater the contribution of that predictor. From the findings in table 4.10, the t-value in the model was as follows; drought-tolerant food crops enterprise, (t= 3.82, P<.05), maize enterprise, (t =1.36, P >.05) and livestock enterprise (t =5.2, P<.05). This implied that drought-tolerant food crops and livestock enterprises have more influence on food security than maize enterprise due to their greater t-values.

CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter contains summary, conclusions drawn, and recommendations of the study. These were based on the findings in chapter four and also on the literature review.

5.2 Summary of the Study

The major factors that determine the choice of farm enterprises along Kerio Valley of Tambach Ward are; feeding habits, environmental factors, land tenure systems, human-wild life conflict, agricultural technologies, and access to credit facilities. The challenge of food security remains high along Kerio Valley of Tambach Ward. More than 50% of households do not cultivate and of those cultivating, 35% cultivate less than 2 acres and 75 % harvest less than 10 bags. Use of technologies is recorded at 40%. The study area receives one successful rainfall and thus one successful harvest once in every 5 years.

The major enterprises postulated in the study were Maize enterprise, Drought Tolerant food crop enterprise and livestock enterprise. Livestock enterprise had the greatest positive significant relationship with food security due to its low vulnerability to adverse environmental conditions followed by drought tolerant food crop enterprise. Maize enterprise had the lowest food security index because it is more vulnerable to poor weather conditions and pest attack coupled with poor storage technologies. Despite these challenges, most households preferred growing maize. This was attributed to high preference of maize crop by households as a staple food crop and better market than other crops.

The results of the study based on the different enterprises indicated a variation in the specific and overall food security indicators as indicated as summarized as follows:-

There was positive relationship between choice of maize enterprise and two of the food security indicators; food availability [$r=.243$, $p<.05$] and food accessibility [$r=.319$, $p<.01$]. There was however negative relationship between the enterprise and food affordability and food nutritional utilization as shown by correlation values of less than 1.0 for each of the indicators. The overall food security index of maize enterprise was [$r=.195$, $p<.05$] which was lower than the other enterprises. Hypothesis test showed that maize enterprise had a beta value of $\beta=0.034$ which implied that maize enterprise had no statistically significant

relationship with food security along Kerio Valley, Tambach Ward. The choice of maize enterprise did not guarantee food security to households throughout the year.

There was positive relationship between choice of drought-tolerant food crops enterprise and food security indicators. The correlation values were; food availability [r=.624, p<.01], food accessibility [r=.618, p<.01], food affordability [r=.449, p<.01] and food nutritional utilization [r=.460, p<.01]. The overall food security index also showed there was a positive relationship between choice of drought-tolerant food crops enterprise and food security [r=.412, p<.01]. Hypotheses test gave a beta value of $\beta 1 = 0.202$ ($p < 0.05$), which indicated that drought-tolerant food crops enterprise had a statistically significant relationship with food security along Kerio Valley, Tambach Ward. The choice of drought-tolerant food crops enterprise enhanced household food security due to higher chances of survival in adverse environmental conditions.

There was a positive relationship between choice of livestock enterprise and food food security indicators; food availability [r=.464, p<.01], food accessibility [r=.581, p<.01], food affordability [r=.563, p<.01], and food nutritional utilization [r=.322, p<.01]. The overall food security index based on choice of livestock enterprise was [r=.504, p<.01]. Hypotheses test showed that $\beta = 0.289$ ($p < 0.05$) which implied that there was statistically significant relationship of choice of livestock enterprise on food security among households living along Kerio Valley, Tambach Ward. This indicates that livestock enterprise contributes more to more food security due to the ability of livestock to withstand adverse environmental conditions than crops and diversity of products from the enterprise**.**

5.3 Conclusions

The following conclusions were drawn based on the research objectives;

i. From the first objective of the study, it was concluded that maize enterprise has no significant relationship with food security among households living in Tambach Ward of Kerio Valley. This was due to the fact that maize enterprise experiences crop failure on annual basis due to low amount of rainfall which affected its availability, accessibility and ability to produce income to buy alternative food. Maize cannot be consumed alone as food, but requires other foodstuff to be nutritionally sound. Households have however

continually grown maize despite its crop failure due to their preference of maize as a food security crop.

ii. From the second objective of the study, it was concluded that choice of drought-tolerant food crops enterprise had a significant relationship with food security among households living along Kerio Valley, Tambach Ward. This was attributed to higher tolerance of drought-tolerant food crops to adverse environmental conditions. The drought-tolerant food crops had higher chances of survival and could also be stored for longer periods than maize. The crops acted as source of income to buy alternative foods and had higher nutritive value than maize.

iii. From the third objective of the study, it was concluded that choice of livestock enterprise had a significant relationship with food security among households living along Kerio valley, Tambach Ward. The choice of livestock enterprise had a strong positive correlation to food security indicators; availability, accessibility, affordability and nutritional utilization. Livestock enterprise makes households more food secure than other enterprises due to its ability to withstand adverse environmental conditions than other enterprises, households kept a variety of livestock such as sheep, goats and cattle that had higher chances of survival than crops. The sustainable supply of livestock products as food throughout the year and provision of income through sale of livestock and their products to buy a variety of foods according to household choice were strengths over other enterprises.

5.4 Recommendations of the study

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

i. Households living along Kerio Valley in Tambach Ward should diversify farm enterprises by prioritizing enterprises with the highest potential to address food security. This implies growing of drought tolerant crops and practicing livestock enterprise to promote food security in Tambach Ward than relying on maize which has no relationship with food security.

ii. The government through the Ministry of Agriculture, Livestock and Fisheries should enhance dry land farming technologies to promote drought tolerant crop enterprise so as to enhance food security in ASAL areas due to its high relationship with food security.

iii. The Government and development partners need should lay strategies to improve value addition of livestock products through construction of abattoirs aimed at increasing household income that will improve affordability of food by households in Tambach Ward hence enhancing food .security along Kerio Valley due to the strong relationship between livestock enterprise and food security.

5.5 Suggestions for further study

From the findings of the study, the following suggestions were put forward;

i) A study on influence of dry land enterprise technologies on food security in Arid and Semi-Arid Lands in North Rift, Kenya.

ii) A study on contribution of livestock enterprise on food security in Arid and Semi-Arid Lands in North Rift, Kenya.

iii) An investigation on the contribution of cash crop enterprises on food security along Kerio Valley, Elgeyo Marakwet County, Kenya.

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APPENDIX A: INTERVIEW SCHEDULE FOR HOUSEHOLD HEADS IN TAMBACH WARD

Introduction

Hallo, my name is Emmanuel Seroney, a Master of Science in Agricultural Extension Student at Egerton University. My study involves an investigation on the influence of farm enterprise choice on food security along Kerio Valley of Tambach Ward. Your contribution will be useful not only in this study but also for future planning by stakeholders for intervention on food security. Your responses are highly valuable and confidential.

SECTION A: Respondent's Bio data

1. Name of Respondent (optional) ----------
2. Location----------
3. Sub-Location----------
4. What is your gender? : ☐ Female ☐
5. What is your age in years?
   - Under 20 years. ☐
   - 21-30 years. ☐
   - 31-40 years. ☐
   - 41-50 years. ☐
   - Over 50 years. ☐
6. What is your highest level of academic qualification?
   - None ☐
   - Primary ☐
   - Secondary ☐
   - College / University ☐

Others, (specify) ----------

7. What is the size of your land in acres?
   - Less than 1.0 acres. ☐
   - 1.1-2.5 acres. ☐
   - 2.6-5.0 acres ☐
   - 5.1-7.5 acres. ☐
   - Over 7.5 acres ☐

SECTION B: Household Food Security.

I) Food availability

In the last five years:-

8. How frequent have your household members been consuming products from the following enterprises?

Enterprise	Never	sometimes	Often	Always
Maize				
Livestock				
Drought-tolerant food crops				
Millet				
Sorghum				
Groundnuts				
Green grams				

9. Is the food produced in your farm from these enterprises adequate for your household members?

Enterprise	Never	sometimes	Often	Always
Maize				
Livestock				
Drought-tolerant food crops				
Millet				
Sorghum				
Groundnuts				
Green grams				

10. Give the frequency of food storage from each of these enterprises?

Enterprise	Never	sometimes	Often	Always
Maize				
Livestock				
Drought-tolerant food crops				
Millet				
Sorghum				
Groundnuts				
Green grams				

11. Have you experienced any storage problems for the product/produce from these enterprises?

Enterprise	Never	sometimes	Often	Always
Maize				
Livestock				
Drought-tolerant food crops				
Millet				
Sorghum				
Groundnuts				
Green grams				

II) Food Accessibility

12. Which enterprise provides most food for your household?

Enterprise	Never	sometimes	Often	Always
Maize				
Livestock				
Drought-tolerant food crops				
Millet				
Sorghum				
Groundnuts				
Green grams				

13. Which of these farm enterprises mostly provides food in times of shortage?

Enterprise	Never	sometimes	Often	Always
Maize				
Livestock				
Drought-tolerant food crops				
Millet				
Sorghum				
Groundnuts				
Green grams				

14. Do you get food from these enterprises in your local market?

Enterprise	Never	sometimes	Often	Always
Maize				
Livestock				
Drought-tolerant food crops				
Millet				
Sorghum				
Groundnuts				
Green grams				

15. Which of these enterprises provide large quantities of food in your local market?

Enterprise	Never	sometimes	Often	Always
Maize				
Livestock				
Drought-tolerant food crops				
Millet				
Sorghum				
Groundnuts				
Green grams				

16. Which food from each of these enterprises does your household prefer consuming?

Enterprise	Never	sometimes	Often	Always
Maize				
Livestock				
Drought-tolerant food crops				
Millet				
Sorghum				
Groundnuts				
Green grams				

III) Food Affordability

17. How frequently do you buy food from the following enterprises for your household?

Enterprise	Never	sometimes	Often	Always
Maize				
Livestock				
Drought-tolerant food crops				
Millet				
Sorghum				
Groundnuts				
Green grams				

18. Do you sell produce /products from these enterprises?

Enterprise	Never	sometimes	Often	Always
Maize				
Livestock				
Drought-tolerant food crops				
Millet				
Sorghum				
Groundnuts				
Green grams				

19. Do you get good prices for the produce/products from the enterprises?

Enterprise	Never	sometimes	Often	Always
Maize				
Livestock				
Drought-tolerant food crops				
Millet				
Sorghum				
Groundnuts				
Green grams				

20. Do you use income from these enterprises to buy food?

Enterprise	Never	sometimes	Often	Always
Maize				
Livestock				
Drought-tolerant food crops				
Millet				
Sorghum				
Groundnuts				
Green grams				

21. Is the income from these enterprises sufficient to buy household food for the whole year?

Enterprise	Never	sometimes	Often	Always
Maize				
Livestock				
Drought-tolerant food crops				
Millet				
Sorghum				
Groundnuts				
Green grams				

22. Which other sources of income do you use to buy food?

Salary /wages

Off-farm activities/Business

Loan

IV) Food Nutritional Utilization

23. Do your household members consume products/produce from each of these enterprises at least three times daily?

Enterprise	Never	sometimes	Often	Always
Maize				
Livestock				
Drought-tolerant food crops				
Millet				
Sorghum				
Groundnuts				
Green grams				

24. Do your household members get sufficient nutrients from produce/products from these enterprises?

Enterprise	Never	sometimes	Often	Always
Maize				
Livestock				
Drought-tolerant food crops				
Millet				
Sorghum				
Groundnuts				
Green grams				

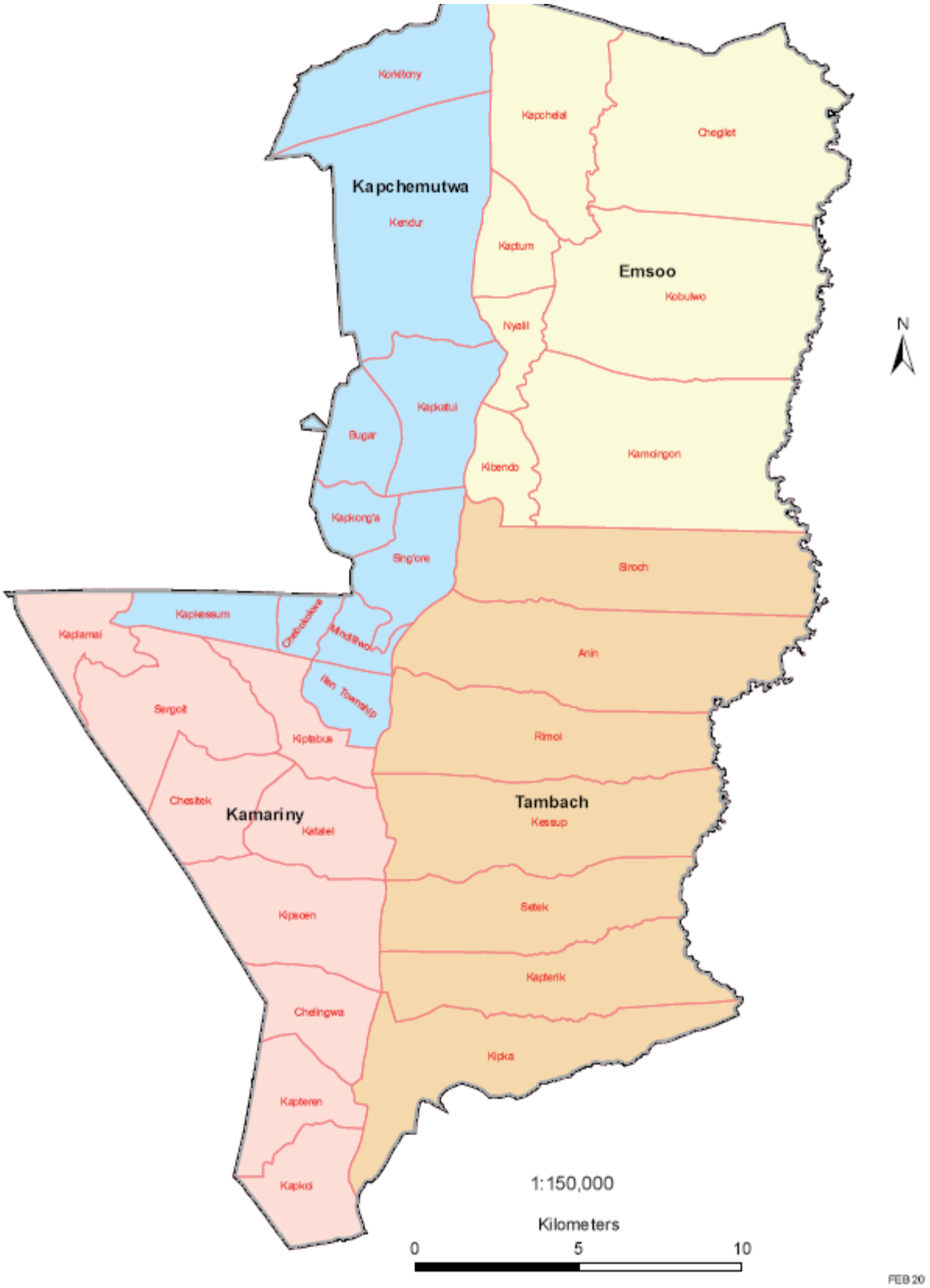
25. Do you use income from each of these enterprises to buy food missing in your diet?

Enterprise	Never	sometimes	Often	Always
Maize				
Livestock				
Drought-tolerant food crops				
Millet				
Sorghum				
Groundnuts				
Green grams				

26. Have your family members experienced any problems associated with the consumption of products / produce from these enterprises?

Enterprise	Never	sometimes	Often	Always
Maize				
Livestock				
Drought-tolerant food crops				
Millet				
Sorghum				
Groundnuts				
Green grams				

APPENDIX B: MAP OF KEIYO NORTH SHOWING TAMBACH WARD



APPENDIX C: AUTHORIZATION LETTER

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

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

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

Ref: No.

Date:

8th October, 2015

NACOSTI/P/15/0762/6400

Emmanuel Kipkorir Seroney
Egerton University
P.O. Box 536-20115
EGERTON.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Influence of choice of farm enterprises on food security among farmers living in Kerio Valley, Tambach Division, Elgeyo Marakwet County"*** I am pleased to inform you that you have been authorized to undertake research in **Elgeyo Marakwet County** for a period ending **7th October, 2016.**

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

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

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

Copy to:

The County Commissioner
Elgeyo Marakwet County.

The County Director of Education
Elgeyo Marakwet County.

APPENDIX D: RESEARCH PERMIT

THIS IS TO CERTIFY THAT:
MR. EMMANUEL KIPKORIR SERONEY
of EGERTON UNIVERSITY, 0-30100
eldoret,has been permitted to conduct
research in *Elgeyo-Marakwet County*

on the topic: *INFLUENCE OF CHOICE OF FARM ENTERPRISES ON FOOD SECURITY AMONG FARMERS LIVING IN KERIO VALLEY, TAMBACH DIVISION, ELGEYO MARAKWET COUNTY*

for the period ending:
7th October,2016

Permit No : NACOSTI/P/15/0762/6400
Date Of Issue : 8th October,2015
Fee Recieved :Ksh 1,000

.....
Applicant's Signature

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

CONDITIONS

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

REPUBLIC OF KENYA

NACOSTI

National Commission for Science, Technology and Innovation

RESEARCH CLEARANCE PERMIT

Serial No. A 6800

CONDITIONS: see back page

APPENDIX E: PUBLISHED PAPER

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Influence of drought tolerant crop farming on food security in ASALs Kenya: A case of Tambach Division, Elgeiyo Marakwet County

[1]Emmanuel Kipkorir Seroney; [2]Dr. James Obara, [3]Dr. Agnes Nkurumwa;
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Abstract: *Food security is an integral component of vision 2030 in Kenya and Sustainable Development goals. Food insecurity is an increasing challenge in Kenya, especially among households in ASALs of Kenya. ASALs comprise 70% of Kenya's land mass. The conditions are not favorable for arable farming but more suitable to Drought Tolerant Crop farming and pastoralism. However, farmers grow maize that constantly experience crop failure and low emphasis has been laid on DTC farming. The purpose of the study was to determine influence of DTC farming on food security in ASALs of Kenya. The study was conducted in Tambach Division, Elgeyo Marakwet County. Survey research design was used. Purposive and stratified sampling were used to sample 108 households heads out of 1200 households in the division. Interview schedule was used to collect data on DTC based on food security indicators; food availability, food accessibility, food affordability and food nutritional utilization. Data was analyzed using SPSS and results accepted at 0.05% level of significance. The Pearson's correlations results were; food availability (r = 0.624), food affordability (r = 0.496), food accessibility (r = 0.618) and food nutritional utilization (r = 0.460) the overall contribution of DTC on food security in the study area was (r = 0.412). this shows that DTC have a high potential to address food insecurity in ASAL areas but farmers have laid low emphasis due to lack of awareness and poor feeding habits. The study proposed the following recommendations; creating awareness for adoption of dry land farming technologies, sensitization of households to increase consumption of DTC and reduce over reliance of maize as food security crop. The study may benefit farmers in ASALs of Kenya, Agricultural extension officers, non- governmental organizations, and government in addressing food security in Kenya.*

Key words: *Food security, Drought Tolerant crops, Dry lands farming Technologies, Feeding habits, ASALs*

I. INTRODUCTION

Food security is an increasing challenge facing most households especially in the developing world (Food and Agricultural Organization, 2003). The type, amount and quality of food produced is progressively declining due to several factors such as changing environmental conditions, slow economic growth, fast population growth, poor agricultural policies, slow and poor adoption of new technologies and poor cultural and religious practices. Sub-Saharan Africa has proportionately the greatest food insecure population with 33 percent of its people undernourished (FAO, 2005). However, some countries like Ghana, Ethiopia and Mozambique have reduced the prevalence of hunger over the Millennium Development Goals (MDG) period to be achieved by 2015. The first MDG sets targets for poverty and hunger reduction. Hunger is a cause as well as a consequence of poverty (Millennium Development Goals, 2005).

More Kenyans are in need of emergency food today than they were 20 years ago and the situation may worsen as indicated by the International Food Policy Research Institute (IFPRI) report for 2009. The report, Global Hunger Index (GHI), that measures levels of malnutrition and hunger shows that Kenya's hunger rating has moved from "serious" to "alarming". Kenya is considered a hunger hot spot and the index shows that it has been falling in food security for the last 20 years compared with other countries (Gachiri, 2009). It is estimated that more than 50 percent of Kenya's population is food insecure, most of them in the pastoral and marginal areas (District Agriculture Office, 2007). The country is increasingly depending on food import/aid as it has continued to import maize, wheat, rice, powder milk and sugar. The Kenyan Government spent Kshs 4.8 million on relief food supplies in the year 2000-2001 (Japanese International Cooperation Agency & Government of Kenya, 2006). Food aid is received from various donor agencies targeting mainly emergency and vulnerable groups.

High cost of food production, adverse weather conditions, increased land sub-division, livestock diseases, inadequate irrigations and poor agricultural policies, have influenced food security negatively in Kerio Valley of Tambach Division (JICA & GOK, 2006; DAO, 2007). Other factors include; human-wildlife conflict and cattle rustling by the Pokot people, who border Tambach Division on the Northern part (World Vision Kenya, 2008).

Within the existing environmental and technological conditions, choice of farm enterprises may be a critical factor influencing food security in Tambach Division. Farmers in Tambach Division practice small-holder mixed farming. Maize is grown as a staple food crop although crop failure is experienced frequently due to adverse weather conditions. Statistics indicate one successful rain, and thus crop harvest once in every five years (JICA & GOK, 2006).

It is imperative that sustainable food security strategies should be initiated and developed by farmers and organizations to allow resources to be channeled to farm enterprises with greater potential to address food insecurity. This will reduce food aid which is costly and less sustainable as well as ensuring donor funds in aid of food security projects are directed to appropriate farm enterprises. Improved food security mechanisms will work towards poverty reduction leading to the attainment of the first MDG. Inappropriate choice of farm enterprises by farmers in Tambach Division may be attributed as one of the factors influencing food security in the area. Little information is available to explain why farmers in Tambach Division have continued to grow maize as a staple food crop yet it is vulnerable to adverse weather conditions than other farm enterprises such as drought-resistant food crop which is less vulnerable to these conditions.

1.2 Statement of the problem

Food security has remained low in Kerio Valley of Tambach Division for many years despite the strategies put in place by the Kenyan Government and Non-governmental organizations through provision of agricultural extension services and food security support programmes. Farmers continually grow maize to provide them with their food needs despite rampant crop failure experienced annually and low emphasis is laid on drought-resistant food crops that is less vulnerable to environmental conditions. Little information is available on influence of drought tolerant crops on food security in Tambach Division.

II. LITERATURE REVIEW

The major challenge to food security in Kenya is the perception that 'food is maize'. On the contrary, indigenous food crops, which are drought tolerant, can act as an alternative source of the much-needed nutrients. The advocacy for indigenous foods has been triggered by the fact that the climatic conditions of dry areas cannot support maize and more so achieve its production potential. There are many grain and root crops that are high yielding and drought tolerant which can contribute to food security in the dry areas of the country (Mataruka, 2010).

The shift to drought tolerant food crop enterprise is not only confined to Africa but also other parts of the world. For instance, in rain fed regions of Australia and North America, investment in Drought-Tolerant (DT) crops are expected to bring large profits. Among the poor in developing dry land areas, gains from DT crops could make the difference between survival and starvation. During a drought, DT crops could limit catastrophic losses and help households recover more quickly. Many proponents argue that adopting DT varieties may also allow farmers to become more entrepreneurial and diversify their livelihoods. In the past decade, more than US $ one billion has been spent on drought tolerance in agriculture research and much is being done. This is in light with climate change, growing water insecurity and renewed concerns about food security (Lybbert, 2010).

Some of the initiatives which have been started in Kenya to promote the growing of DT crops include the RINCOD project. In its contribution towards spearheading food security effort in Kenya, RINCOD has initiated the following approach: sensitization on agricultural productivity, diversification, formation and training of production groups, enhancing group's skills in value addition, promotion of indigenous crop enterprise as a business and establishment of cottage industries. This study supports sensitization on food security through agricultural production diversification by promoting indigenous crop enterprise. Some of the success stories of the RINCOD project have been reported in some parts of Kenya (Mataruka, 2010).

In Muranga, groups have started production of indigenous foods and have obtained good results, while in Mutomo District RINCOD cassava project has established a drought tolerant cassava (*Manihot esculanta*) with an overall objective of enhancing food security. As a drought-tolerant crop, cassava has many advantages such as: it can survive harsh climate where other crops may not do well, grows in low-nutrient soils, roots can be stored in the soils for between 24 to 36 months; providing a good preservation method for the food reserves for household, leaves act as vegetables providing proteins, vitamins A and B and minerals, while roots have a high concentration of carbohydrates; about 80 percent (Mataruka, 2010). Expansion of such a project may be useful to farmers along Kerio Valley. Many of Africa's small-scale farmers will become increasingly vulnerable including those in Kerio Valley; hence strategies need to be put in place to ensure food security and prosperity for the nations of Sub-Saharan Africa. More food security problems are predicted in the future and scientists recognize that drought tolerance is one of the most desirable traits to target in breeding better crops for Africa and globally.

The DT crops which have a high potential in Kerio Valley include: cereals (millet and sorghum); legumes (beans, cowpeas, pigeon peas and green grams); root crops (sweet potatoes, cassava and groundnuts); and fruits (citrus, mangoes, bananas, pawpaw and watermelon). Among the cereal crops with high potential in the Division are millet and sorghum. These crops have registered low levels of production at 16 percent for millet

and four percent for sorghum due to low emphasis laid on them by farmers (DAO, 2007). Millet and sorghum are drought resistant cereal crops which do well in marginal areas with low amounts of rainfall. Millet for instance is grown mainly in low rainfall areas for subsistence and is particularly important as a food security crop because of its nutritive value and grain storage can take long periods without any pest damage (National Research Council, 1996).

2.1 Food Security Indicators

There are different indicators which can be used to describe Household Food Security (HFS). They mainly encompass process indicators and outcome indicators of food security. Process indicators are measures that reflect both supply and access to food by households; they include food availability, food accessibility, food affordability and food nutritional utilization. On the other hand, outcome indicators are measures which serve as proxies for food consumption. They fall in two categories namely direct and indirect indicators (Frankenberg, 1992)

One critical dimension of HFS is the availability or supply of food in the area for the household. Regional food shortages have a strong influence on household food availability (Frankenberg, 1992). Borton and Shoham (1991), classify the commonly used availability indicators in food monitoring systems as inputs and measures of agricultural production which include agro-meteorological data, access to natural resources, institutional development and market infrastructure and exposure to regional conflicts or its consequences such as influx of refugees. These indicators are not mutually exclusive of food access indicators and considerable overlap and interaction between the two categories may exist (Frankenberg, 1992).

It has been realized that household food insecurity and famine conditions were occurring despite the availability of food. Researchers and development practitioners realized that food insecurity occurred in situations where food was available but not accessible because of an erosion of people's entitlement to food (Borton & Shoham, 1991). A theory of food entitlement by Sen had a considerable influence on this shift in thinking. Entitlement involves how much food households actually have access to food from their own production, income, gathering of wild foods, community support/claims, assets and migration. Thus, a number of socio-economic variables have an influence on household access to food. Food entitlement and effective demand of households are now seen as crucial to HFS (Sen, 1981).

The ability of households to meet their food needs through buying will indicate their level of food security. The income obtained from enterprises and relative prices of food will determine the affordability of food. There are two methods which are generally used to determine affordability as an indicator of food security; 1) Limit consideration to food grain consumption; 2) Conversion of all food items to their calorie content (O' Brien-place & Frankenberg, 1989).

Nutritional Surveys estimates the prevalence of malnutrition in a population by measuring the nutritional status of a random sample of children less than five years, weight for age and height for age is widely used in nutrition surveillance programs. In adults, the 24 -hour recall dietary diversity is used to determine the types of food consumed food consumed forming a balanced diet of the population. A household which consumes carbohydrates, proteins and fats is likely to be more food secure than a family who doesn't. The frequency of consumption of these food components can be used to assess the level of household food security (Kumar, 1989). The use of this method is however associated with problems. Nutritional status is as a result of several factors in addition to food consumption and does not always correlate directly with food availability and access.

III. METHODOLOGY

3.1 Research Design

A survey research design was used to collect data from farm households on the influence of choosing major farm enterprises on food security in Tambach Division. The purpose of survey research design is to explore and describe the characteristics of a population under study to allow the researchers to gather information, summarize, present and interpret for the purpose of clarification (Orodho, 2002). In this study, the level of contribution of each of the farm enterprises towards food security in Kerio valley was described and the factors influencing the choice of the farm enterprises identified. The design involves collection of data in a section of a population at one point in time (Fraenkel & Wallen, 2000).

3.2 Study Location

The study was carried out in Tambach Division of Keiyo North Sub County. The Sub County forms one of the four Sub Counties making up Elgeyo-Marakwet County. The Sub County covers an area of 541 km^2, with a population of 73,715 people, according to Kenya National Bureau of Statistics (2009). The District comprises of two Divisions namely Tambach and Kamariny. Tambach Division is made up of four locations and 15 Sub locations and covers an area of 331 km^2. There are 5,160 households with a total population of 22,719 and a population density of 69 people per kilometer square (KNBS, 2009). Keiyo North Sub county is divided into three agro-ecological zones; Keiyo highlands, Keiyo escarpment and Kerio Valley. The study was carried out in Kerio Valley of Tambach Division leaving out the escarpment and the highlands due to their low prevalence to food insecurity.

The four locations making up Tambach Division are; Kokwao, Keu, Kamogich and Kiptuilong. The latter three have various proportions of their parts lying in the Valley as shown in Table 1.

Table 1: Proportions of Tambach Locations in Kerio Valley

Location	Proportion in the Valley (%)
Keu	100
Kamogich	25
Kiptuilong	25

Source: Keiyo North Sub County Agriculture Office, 2007

Kerio Valley is characterized by an altitude of between 1000-1200 meters above the sea level, and rainfall ranging between 400-850 millimeters per annum; which is highly erratic and insufficient. The soils from ashes of old volcanic and basement rocks, are of moderate fertility and suitable for cultivation due to their richness in organic matter. These soils are, however threatened by erosion due to sparse vegetation, high and torrential run offs and overgrazing.

3.3 Target Population

The total population in these locations is 16,790 people. There are 2,786 households (KNBS, 2009). Details of population and number of households per location are shown in Table 2. The target population consisted of all small holder farmers who practice mixed farming in three locations of the Division namely Keu, Kamogich and Kiptuilong who are predominantly Keiyo sub tribe from Kalenjin tribe.

The final sample consisted of 120 household heads selected from 2,786 households in the three locations in the Division. A minimum sample size of 100 is considered appropriate for social science studies (Kathuri & Pals, 1993). The extra number of 20 households catered for dropouts and non-respondents during the study. These proportionate samples are based on the population and proportion of each location found in Kerio Valley. Agricultural extension officers guided and provided relevant information in the study. Specific sample sizes for the selected locations are shown in Table 3.

Table 2: Number of Households and Proportionate Sample Sizes per Location

Location	Total Number of Households	Proportion of Households	No. of Households
Keu	1,000	0.36	43
Kamogich	925	0.33	40
Kiptuilong	861	0.31	37
Total	**2,786**	**1.00**	**120**

3.4 Data collection instrument

The study used interview schedule to collect data from farmers. A structured interview schedule was administered by the researcher to collect information from farmers on farm enterprises practiced, factors determining farm enterprise choice Status of growing drought-resistant food crops and household food security as relates to food availability, accessibility, affordability and nutritional utilization. The instrument is appropriate in collecting information from farmers with low levels of literacy as it allows for clarification of any ambiguity and does not discriminate against the less articulate respondents (Leung, 2001).

3.5 Data Analysis

Data from interview schedules was organized, collated and coded according to study objectives and variables. Summarized data was entered into the computer for analysis using the Statistical Package for Social Sciences (SPSS). Data was analyzed using descriptive and inferential statistics. Inferential statistics used were Pearson's product moment correlation and regression analysis. Descriptive statistics used was frequencies and percentages to describe the factors influencing choice of farm enterprises and the level of contribution of each enterprise towards food security.

IV. FINDINGS

4.1 Influence of choice of Drought Resistant food Crop enterprise on food security

The second research objective was to establish the influence of choice of drought resistant food crop enterprise on food security. This was achieved through the use of both descriptive and inferential statistics. The food security was determined using the food security indicators such as; availability, accessibility, affordability and nutritional utilization.

4.2 Correlations on the Influence of Drought Resistant food Crop enterprise on Food Security

Pearson Correlation Coefficient was used to determine influence of drought resistant food crop enterprise on food security as shown in Table 3. There was positive relationship between choice of drought resistant food crop enterprise and food security availability [$r=.624$, $p<.01$]. This indicates that an increase in choice of drought resistant food crop contributes to more food availability, thus making the farmers become food secure. Also a positive correlation exist between drought resistant food crop enterprise and food security accessibility [$r=.618$, $p<.01$]. This indicates that an increase in choice of drought resistant food crop enterprise and adequate supply in the market makes food accessible, thus farmers become more food secure.

Moreover, a positive relationship existed between choice of drought resistant food crop enterprise and food security affordability [r=.449, p<.01]. This implies that an increase in choice of drought resistant food crop enterprise enable farmers get income that has led to improved capacity to buy food and farmers becoming food secure. Finally, a positive correlation existed between choice of drought resistant food crop and food security nutritional utilization [r=.460, p<.01]. This imply that the more farmers chose drought resistant food crop enterprise, the higher the chances of being in a position to obtain food of better nutritional utilization.

Table 3: Influence of Drought Resistant Food Crop Enterprise on Food Security

		Drought resistance food crop	Availability	Accessibility	Affordability	Utilization
Drought resistance food crop	Pearson Correlation	1				
	Sig. (2-tailed)					
Availability	Pearson Correlation	.624**	1			
	Sig. (2-tailed)	.000				
Accessibility	Pearson Correlation	.618**	.580**	1		
	Sig. (2-tailed)	.000	.000			
Affordability	Pearson Correlation	.449**	.378**	.496**	1	
	Sig. (2-tailed)	.000	.000	.000		
Nutritional Utilization	Pearson Correlation	.460**	.255**	.449**	.456**	1
	Sig. (2-tailed)	.000	.008	.000	.000	

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

N=109

The positive relationship between choice of drought resistant food crop and food security availability was attributed to higher tolerance of drought resistance food crops than maize, that require more rainfall. Also a positive correlation exists between drought resistant food crop enterprise and food security accessibility, since farmers sell the produce to buy other food crops including maize. Moreover, a positive relationship exist between choice of drought resistance food crop enterprise and food security affordability, as farmers could have the capacity and capability to purchase the food crops from income obtained from sale of produce from income obtained from sale of produce. Finally, a positive correlation existed between choice of drought resistant food crop and food security nutritional utilization, since the crops provide a wide range of nutrients necessary to improve the diet of the farmers.

4.3 Overall Correlation on Drought Resistant food Crop enterprise and Food Security

The food security indicators were computed to form an index of food security and correlated to drought resistant food crop enterprise choice as indicated in Table 4. There was positive relationship between choice of drought resistant food crop enterprise and food security [r=.412, p<.01]. This indicates that an increase in choice of drought resistant food crop enterprise contributes to more food security among the farmers in Tambach division of Kerio Valley. The overall drought resistant food crop was higher as compared to maize enterprise. This indicates that the drought resistant food crop enterprise that withstands adverse environmental conditions than maize crop enterprises. These placed farmers in a better opportunity to handle food security challenges.

Table 4: Choice of Drought Resistant Food Crop Enterprise and Food Security

		Drought enterprise	Food security
DRFC enterprise	Pearson Correlation	1	.412**
	Sig. (2-tailed)		.000
Food security	Pearson Correlation	.412**	1
	Sig. (2-tailed)	.000	

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

N=109

V. CONCLUSIONS AND RECOMMENDATIONS

There was a statistically significant influence of drought tolerant crop farming on food security in Tambach Division of Kerio valley. The positive relationship between drought resistant food crop and food security indicators; food availability, food accessibility, food affordability and food nutritional utilization was attributed to higher tolerance of drought tolerant food crops than maize, that require more rainfall. The crops were more

available to farmers because they have higher chances of survival and can be stored for longer periods than maize. They also act as source of income to buy other food and they have better nutritive value than maize.
The study proposed the following recommendations; creating awareness for adoption of dry land farming technologies, sensitization of households to increase consumption of DTC and reduce over reliance of maize as food security crop, intensify irrigation, and development of more maize tolerant varieties. The study may benefit farmers in ASALs of Kenya, Agricultural extension officers, Government and Non- Governmental organizations in addressing food security in Kenya.

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